COMMONWEALTH OF VIRGINIA

STATE CORPORATION COMMISSION

PREFILED STAFF TESTIMONY

VIRGINIA POWER AND ELECTRIC COMPANY

In re: Virginia Electric and Power Company's Integrated Resource Plan filing pursuant to Va. Code § 56-597 et seq.

Volume I of II

PUR-2023-00066

August 22, 2023

TABLE OF CONTENTS

VOLUME I

VOLUME II

PART A

Direct Testimony Summary - Bernadette Johnson

Enverus, Inc., ("Enverus") was engaged by the Staff of the Virginia State Corporation Commission to provide comparable forecasts and methodology review of Dominion Energy Virginia's ("Dominion" or "Company") 2023 Integrated Resource Plan ("IRP") filing. My key findings include:

Comparison of Commodity Price forecasting methodologies:

- The Company, PJM Interconnection, LLC., and Enverus all employ different methodologies depending on the forecast subject item; however, all use scientific approaches that can reasonably be expected to map to a legitimately possible outcome.
- Forecasting in the current global environment has become increasingly difficult due to extraordinary global events resulting in extremely volatile commodity prices and consumption patterns that are largely unprecedented in the past 10 years. Therefore, differences in the forecasts are not surprising and can be expected.
    - The Company's price forecasts rely on analysis provided by ICF Resources, LLC. ("ICF") as of February 28, 2023.
    - Enverus agrees with the final statement of IRP Section 4.4: "The commodity price forecasts analyzed in the 2023 Plan present reasonably likely outcomes given the current understanding of market fundamentals, but do not present all possible outcomes."
    - Enverus agrees with the approach of blending observable forward market prices when available and transparent because the inherent "crowd-sourcing" nature of forward markets is naturally resistant to a single analyst outlier viewpoint.
- Enverus also notes the forecast date (February 28, 2023) is reasonably timely given all of the administrative burdens of preparing an IRP Plan.
- The Enverus forecasts were generated on or about June 22, 2023.
- Price Forecasts for both fuel and power prices between the Company and Enverus do differ but not in an unacceptable manner. Variances are mostly attributable to a difference in timing of when the forecasts were created.

Differences:

- The three areas where Enverus differs most from the Company are:
    - Energy Sales and Peak Load forecasts
    - Capacity Price forecast
    - REC Price forecast

PRE-FILED TESTIMONY
OF
BERNADETTE JOHNSON

DOMINION ENERGY VIRGINIA
2023 INTEGRATED RESOURCE PLAN

CASE NO. PUR-2023-00066

Q. PLEASE STATE YOUR NAME AND OCCUPATION.

A. My name is Bernadette Johnson, and I am General Manager, Power & Renewables, for Enverus, Inc. ("Enverus").

Q. PLEASE DESCRIBE YOUR BACKGROUND AND QUALIFICATIONS.

A. As the General Manager of the Power & Renewables business unit at Enverus, I oversee all consulting engagements and research efforts related to the power industry. Over my career in the energy industry, I have accrued extensive experience providing crude and natural gas fundamentals analyses and advisory services to various players in North American and global energy markets. My specific market experience spans financial trading, production forecast and reserve analysis, infrastructure analysis, processing/gathering/refining analysis, storage valuation, and regional and benchmark price forecasting. My analysis has been utilized by numerous entities in the energy space for evaluating investments and specific transactions. Our client list includes several Fortune 500 companies, and our research was referenced and cited in the EIA[1] Quadrennial Energy Review. I joined Enverus through the acquisition of products and services from Ponderosa Advisors in November 2016. As a founding partner at Ponderosa Advisors, I

[1] U.S. Energy Information Administration.

led the Energy Analytics team and was responsible for all related consulting engagements and market research efforts. Prior to joining Ponderosa Advisors, I was a Senior Research Analyst for Sasco Energy Partners in Westport, CT. In this role, I provided and managed fundamentals research for a team of financial traders active in natural gas, power, and oil futures markets. I began my career at Bentek Energy, as a Senior Energy Analyst, Natural Gas Market Fundamentals and consulting project team lead. I hold an MS Degree in International Political Economy of Resources, and a BS Degree in Economics from the Colorado School of Mines.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. Enverus was engaged by the Staff of the Virginia State Corporation Commission to:

1) Provide its proprietary benchmark and basis 25-year price forecasts for Natural Gas (Henry Hub); Coal; #2 Oil; #6 Oil; PJM-DOM On-Peak Power Prices; and PJM-DOM Off-Peak Power Prices.
2) Review Dominion Energy Virginia's ("Dominion" or "Company") 25-year commodity and power price forecasts contained in its 2023 Integrated Resource Plan ("IRP"), and compare and contrast them with Enverus' commodity and power price forecasts.
3) Review Dominion's 25-year commodity and power price forecasts from prior IRPs (2009 - 2022) and Renewable Portfolio Standard ("RPS") Plans (2020 - 2022) and provide a detailed discussion on Dominion's track record in making accurate commodity and power price forecasts.
4) Provide Energy Sales and Peak Load 25-year forecasts for the PJM-DOM Zone and the Dominion Load Serving Entity. Provide Peak Load forecasts for the PJM[2] Summer Coincident Peak, the Summer Non-Coincident Peak, and the Winter Non-Coincident Peak. Compare and contrast Enverus' Energy Sales and Peak Load forecasts with Dominion's forecasts contained in its 2023 IRP and with PJM's 2023 forecasts.
5) Review Dominion's 25-year Energy Sales and Peak Load forecasts from prior IRPs (2009 - 2022) and RPS Plans (2020 - 2022) and provide a detailed discussion on Dominion's track record in making accurate Energy Sales and Peak Load forecasts.

[2] PJM Interconnection, LLC. ("PJM")

6) Review Dominion's Regional Greenhouse Gas Initiative ("RGGI") and national CO_2 pricing included within its model and compare it to other RGGI and CO_2 forecasts available. Provide a detailed discussion on the reasonableness of including RGGI and national CO_2 price within the planning model.
7) Provide a 15-year renewable energy certificate ("REC") forecast for the PJM region.
8) Review Dominion's load, commodity price, market price, and energy sales forecasts and forecasting methodologies and provide a detailed discussion of the reasonableness of the forecasting methodologies, assumptions, and inputs.
9) Provide a 15-year capacity price forecast for the DOM Zone within PJM.

Q. PLEASE PROVIDE A SUMMARY OF YOUR FINDINGS.

A. Enverus' conclusions include the following:

Forecast Comparison:

- The Company, PJM, and Enverus all employ different methodologies depending on the forecast subject item; however, all use scientific approaches that can reasonably expected to map to a legitimately possible outcome.
- Forecasting in the current global environment has become increasingly difficult due to extraordinary global events resulting in extremely volatile commodity prices and consumption patterns that are largely unprecedented in the past 10 years. Therefore, differences in the forecasts are not surprising and can be expected.
    - The Company's price forecasts rely on analysis provided by ICF Resources, LLC. ("ICF") as of February 28, 2023.
    - The Company provides a robust and transparent discussion of its methodology in Chapter 4 of the 2023 IRP.
    - Per Section 4.4 – Commodity Price Assumptions, the Company utilizes a single source, ICF, to provide multiple scenarios for the commodity price forecasts to ensure consistency in methodologies and assumptions.
    - For most commodity prices, the Company uses forward market prices as of February 28, 2023 for the first 18 months, blended forward prices with ICF estimates for the next 18 months, and ICF forecasts exclusively beyond the first 36 months.
    - Forecasts for capacity and Federal CO_2 prices are provided by ICF for all years forecasted within this 2023 Plan.
    - Enverus also uses a blend of market prices and analyst generated outlooks. The mixture of market and analyst outlooks varies depending on the reliability

of the observable market and likely differs from that used by the Company, but both approaches represent best-efforts at identifying a reasonable outlook.
    - Enverus agrees with the final statement of IRP Section 4.4: "The commodity price forecasts analyzed in the 2023 Plan present reasonably likely outcomes given the current understanding of market fundamentals, but do not present all possible outcomes."
    - Enverus agrees with the approach of blending observable forward market prices when available and transparent because the inherent "crowd-sourcing" nature of forward markets is naturally resistant to a single analyst outlier viewpoint.
- Enverus also notes the forecast date (February 28, 2023) is reasonably timely given all of the administrative burdens of preparing an IRP Plan.
- Enverus relies more heavily on machine learning in load forecasting in order to better capture trends that may not be apparent in subjective observance of econometric data.
- The Enverus forecasts were generated on or about June 22, 2023.
- Where the forecasts differ, Enverus attempts to highlight the differences in outlook/view as compared to simply the difference in timing.
- Price Forecasts for both fuel and power prices between the Company and Enverus do differ but not in an unacceptable manner. Variances are mostly attributable to a difference in timing of when the forecasts were created. In addition, there are reasonable differences in the outlook for near-term effects of recent global volatility.

Differences:

- The three areas where Enverus differs most from the Company are:
    - Energy Sales and Peak Load forecasts
    - Capacity Price forecast
    - REC Price forecast

Q. PLEASE IDENTIFY THE SCHEDULES ATTACHED TO YOUR TESTIMONY.

A. The following schedule is attached to my testimony as Attachment BJ-1:

- SUMMARY REPORT & FINDINGS - Case No. PUR-2023-00066 - Dominion Energy Virginia's 2023 Integrated Resource Plan.

My testimony will sponsor and support the report in its entirety.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

SUMMARY REPORT & FINDINGS
Case No. PUR-2023-00066

Dominion Energy Virginia's 2023 Integrated Resource Plan

Written for: VA SCC | Jun 2023
Prepared by: Bernadette Johnson,
GM, Power & Renewables

Table of Contents

Introduction

The findings contained in this report are presented in accordance with the Statement of Work (SOW) for Contract #SCC-21-002-PUR 6 between the Staff of the Virginia State Corporation Commission and Enverus.

Enverus generated 25-year forecasts for the fuel commodity prices and power prices identified in the SOW. In addition, energy sales and peak load forecasts were created for the desired locations.

Enverus's forecasts are compared to those included in the 2023 Dominion Energy Virginia ("DEV") Integrated Resource Plan ("IRP") filing. Enverus also compared forecasts included in DEV's historical IRPs (dating back to 2009 where available) to actual market results.

Unless otherwise noted, Enverus's forecasts were prepared as of June 2023.

Enverus's analysis is influenced by historical price and load data (from both publicly available and subscription-based sources), observable forward market pricing, and proprietary forecasting and optimization methodologies.

A description of Enverus's methodologies for both power price forecasts and load forecasts is included in the Appendix to this report.

Table of Acronyms

Acronym	Definition
CAPP CSX	Central Appalachian Rail (coal price assessment)
DEV	Dominion Energy Virginia
DEV-LSE	DEV Load Serving Entity service territory
IRP	Integrated Resource Plan
LSE	Load Serving Entity
PJM	PJM is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of 13 states and the District of Columbia. States served by PJM include Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.
PJM-DOM	Dominion Zone of PJM
SOW	Statement of Work
REC	Renewable Energy Certificate
RGGI	Regional Greenhouse Gas Initiative
RPS	Renewables Portfolio Standard
YoY	Year over Year

Summary of Findings

Forecast comparison:

- The Company, PJM, and Enverus all employ different methodologies depending on the forecast subject item; however, all use scientific approaches that can reasonably expected to map to a legitimately possible outcome.
- Forecasting in the current global environment has become increasingly difficult due to extraordinary global events resulting in extremely volatile commodity prices and consumption patterns that are largely unprecedented in the past 10 years. Therefore, differences in the forecasts are not surprising and can be expected.
    - The Company's price forecasts rely on analysis provided by ICF Resources, LLC ("ICF") as of 02/28/2023.
    - The Company provides a robust and transparent discussion of its methodology in Chapter 4 of the 2023 IRP.
    - Per Section 4.4 – Commodity Price Assumptions, the Company utilizes a single source—ICF—to provide multiple scenarios for the commodity price forecasts to ensure consistency in methodologies and assumptions.
    - For most commodity prices, the Company uses forward market prices as of 02/28/2023 for the first 18 months, blended forward prices with ICF estimates for the next 18 months, and ICF forecasts exclusively beyond the first 36 months.
    - Forecasts for capacity and Federal CO_2 prices are provided by ICF for all years forecasted within this 2023 Plan.
    - Enverus also uses a blend of market prices and analyst generated outlooks. The mixture of market and analyst outlooks varies depending on the reliability of the observable market and likely differs from that used by the Company, but both approaches represent best-efforts at identifying a reasonable outlook.

Summary of Findings (continued)

- Enverus agrees with the final statement of IRP Section 4.4: The commodity price forecasts analyzed in the 2023 Plan present reasonably likely outcomes given the current understanding of market fundamentals, but do not present all possible outcomes.
- Enverus agrees with the approach of blending observable forward market prices when available and transparent because the inherent 'crowd-sourcing' nature of forward markets is naturally resistant to a single analyst outlier viewpoint.

- Enverus also notes the forecast date (02/28/2023) is reasonably timely given all of the administrative burdens of preparing an IRP Plan.

- Enverus relies more heavily on machine learning in load forecasting in order to better capture trends that may not be apparent in subjective observance of econometric data.

- The Enverus forecasts were generated on or about 6/22/2023.

- Where the forecasts differ Enverus attempts to highlight the differences in outlook/view as compared to simply the difference in timing.

- Price Forecasts for both fuel and power prices between the Company and Enverus do differ but not in an unacceptable manner. Variances are mostly attributable to a difference in timing of when the forecasts were created. In addition, there are reasonable differences in the outlook for near-term effects of recent global volatility.

Differences:

- The three areas where Enverus differs most from the Company are:

1. Energy Sales and Peak Load forecasts
2. Capacity Price forecast
3. REC Price forecast

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Summary of Findings (continued)

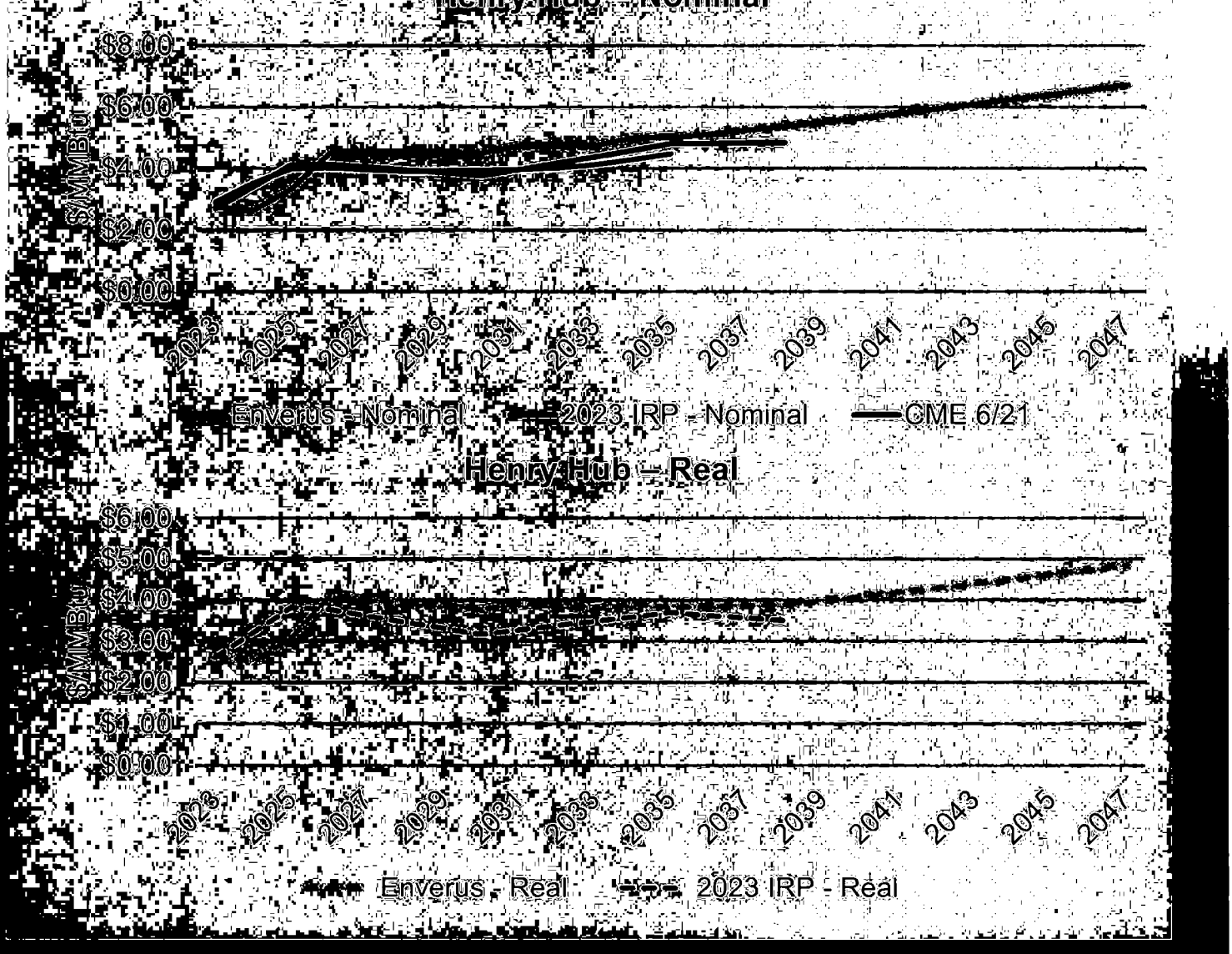
- All three are explained in more details throughout the report. Much of the differences originate from the newly optimistic load growth forecasts from both PJM and the Company.
- These forecasts are primarily driven by expectations of very large growth in datacenter load. While Enverus acknowledges this is a new phenomenon and deserves serious attention, our outlook calls for a smaller amount of growth for reasons outlined in the report.

Historical forecast performance

- When comparing actual prices to the Company's forecasts after the fact, the short-term portion of the forecasts are generally accurate.
- For IRPs filed more than 2-3 years ago, the trend across the long-term portion of both price and sales forecasts exhibited overly optimistic positive trajectories that were not supported by actual results.
- However, that pattern began to be corrected with recent IRPs (2021 and 2022) which appeared to have reasonable outlooks for both prices and sales.
- The onset of the datacenter debate appears to have disrupted this trend. Much uncertainty remains about what lies ahead. Enverus cautions against demand/sales forecasts that rely too heavily on one sector of demand; in this case the "commercial sector." Referencing the 2023 IRP Appendices (Tab 4A) the forecast for the DEV LSE indicates the Commercial sector will make up nearly 50% of demand by 2026 and 68% by 2038. While no growth is projected for the Residential & Industrial segments.

Enverus Natural Gas 25-Year Price Forecasts – Henry Hub

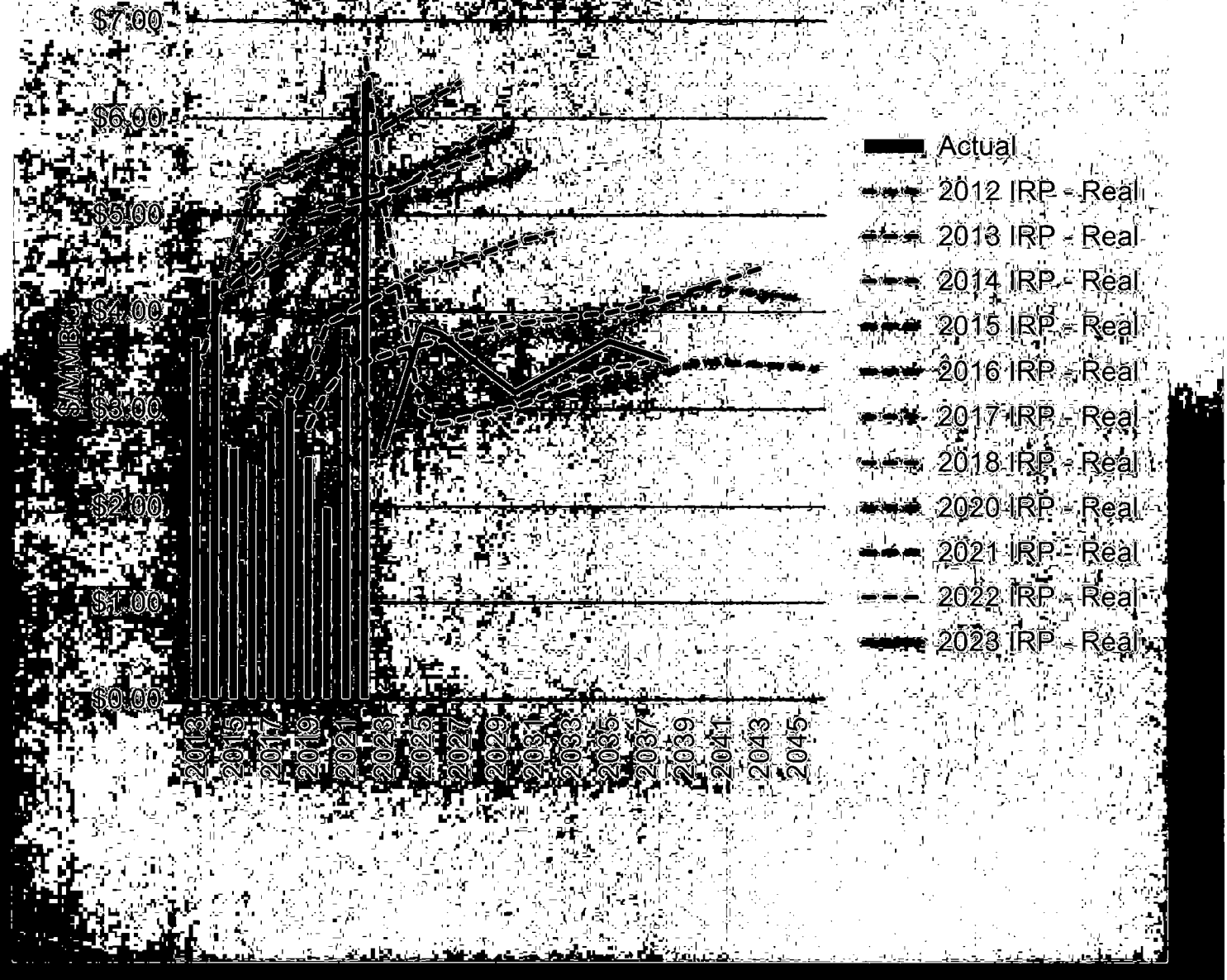
- Enverus forecasts Henry Hub prices based on proprietary production and demand forecasts.
- The methodology determines the price level necessary to economically incent an appropriate amount of supply in order to meet forecasted demand.
- For the period of 2023-2024, with growing production in the Permian and Haynesville basins, Enverus anticipates weaker prices as supply outpaces demand.
- After 2025, as new LNG export capabilities come online, Enverus believes the global call on North American supply coupled with declining core shale inventory will drive prices higher.
- This long-term outlook is modestly higher than the DEV forecast. But Enverus has no strong objection to the DEV forecast.



Historical DEV IRP Natural Gas Price Forecasts By Plan Year – Henry Hub

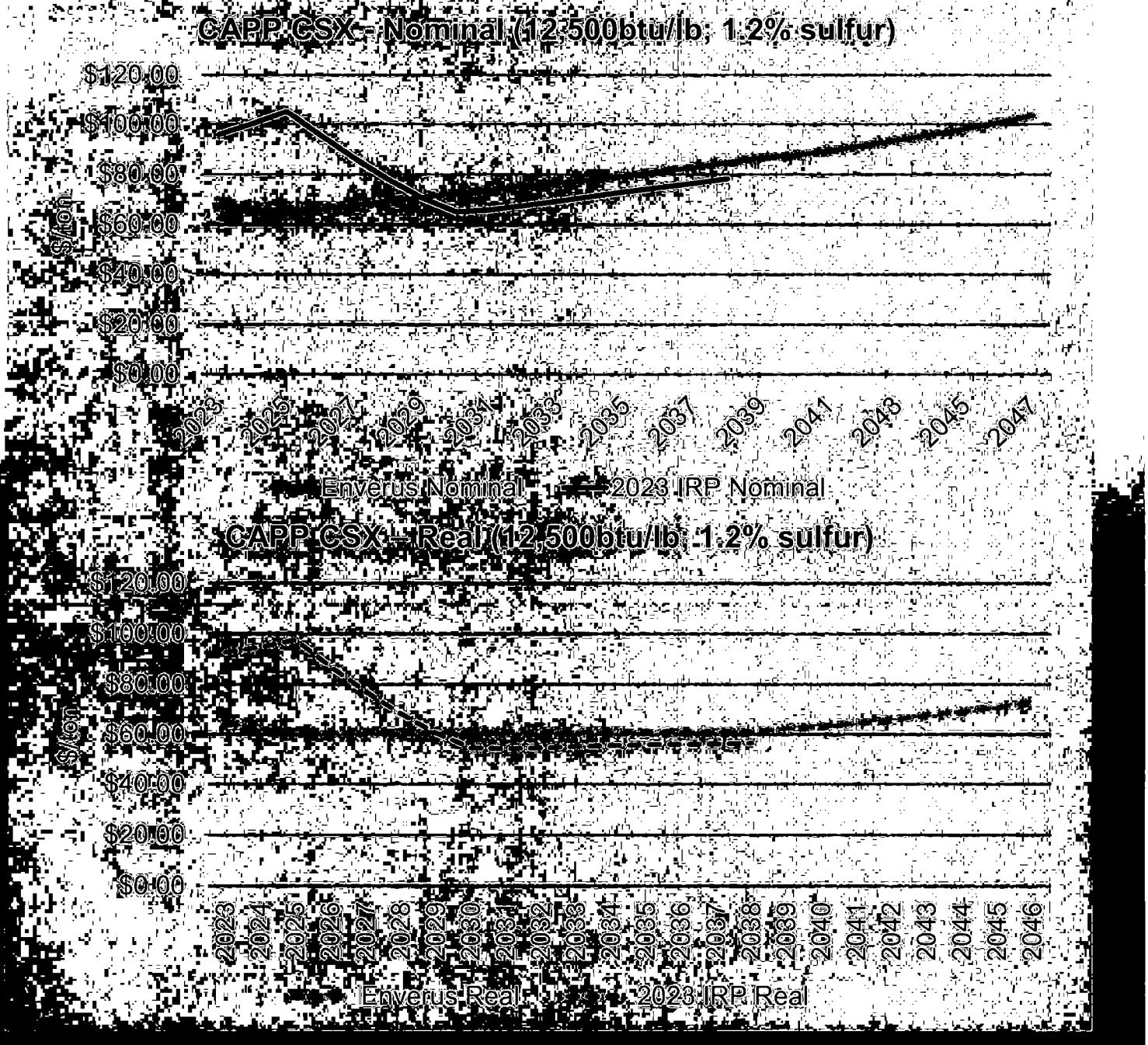
- The chart below shows historical IRP forecasts vs. actuals.
- Since 2012, Henry Hub natural gas prices have been revised down every year in accordance with actual market results.
- DEV's forecasts have been progressively improving to exhibit a market outlook supported by the realities of the shale revolution.
- In 2022 the forecast also correctly adjusted for the near-term volatility brought on by global events followed by a return to a balanced market.

Historical IRP Forecasts vs Actuals – Henry Hub



Enverus 25-Year Price Forecasts – Coal

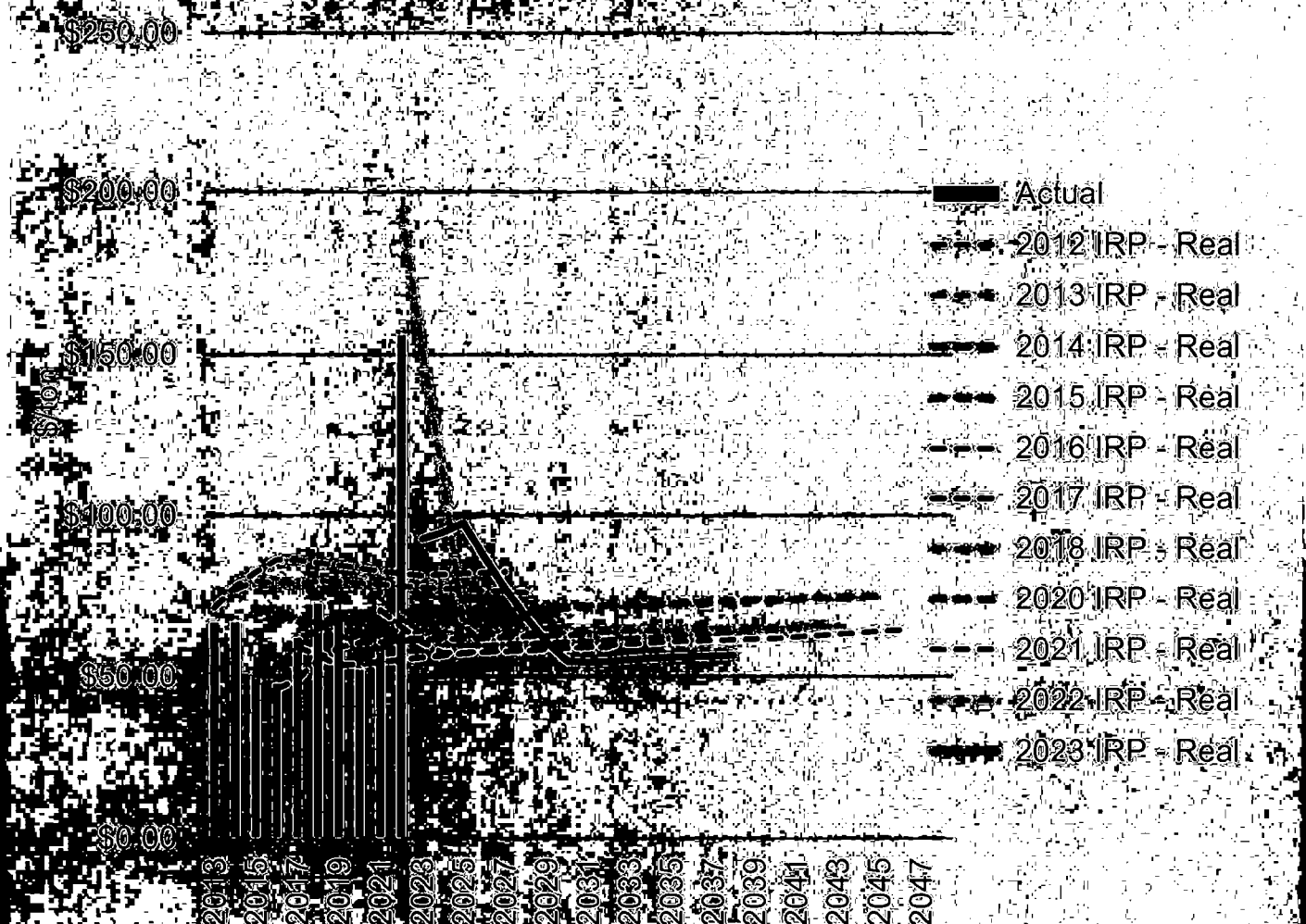
- Enverus utilizes a combination of the EIA Annual Energy Outlook and market quotes from Evolution Markets to forecast coal prices.
- Enverus and DEV's forecasts are similar and Enverus has no objection to DEV's coal price forecasts.
- Any differences are likely attributable to the difference in timing of when the forecasts were generated.



DEV Historical IRP Price Forecasts – Coal

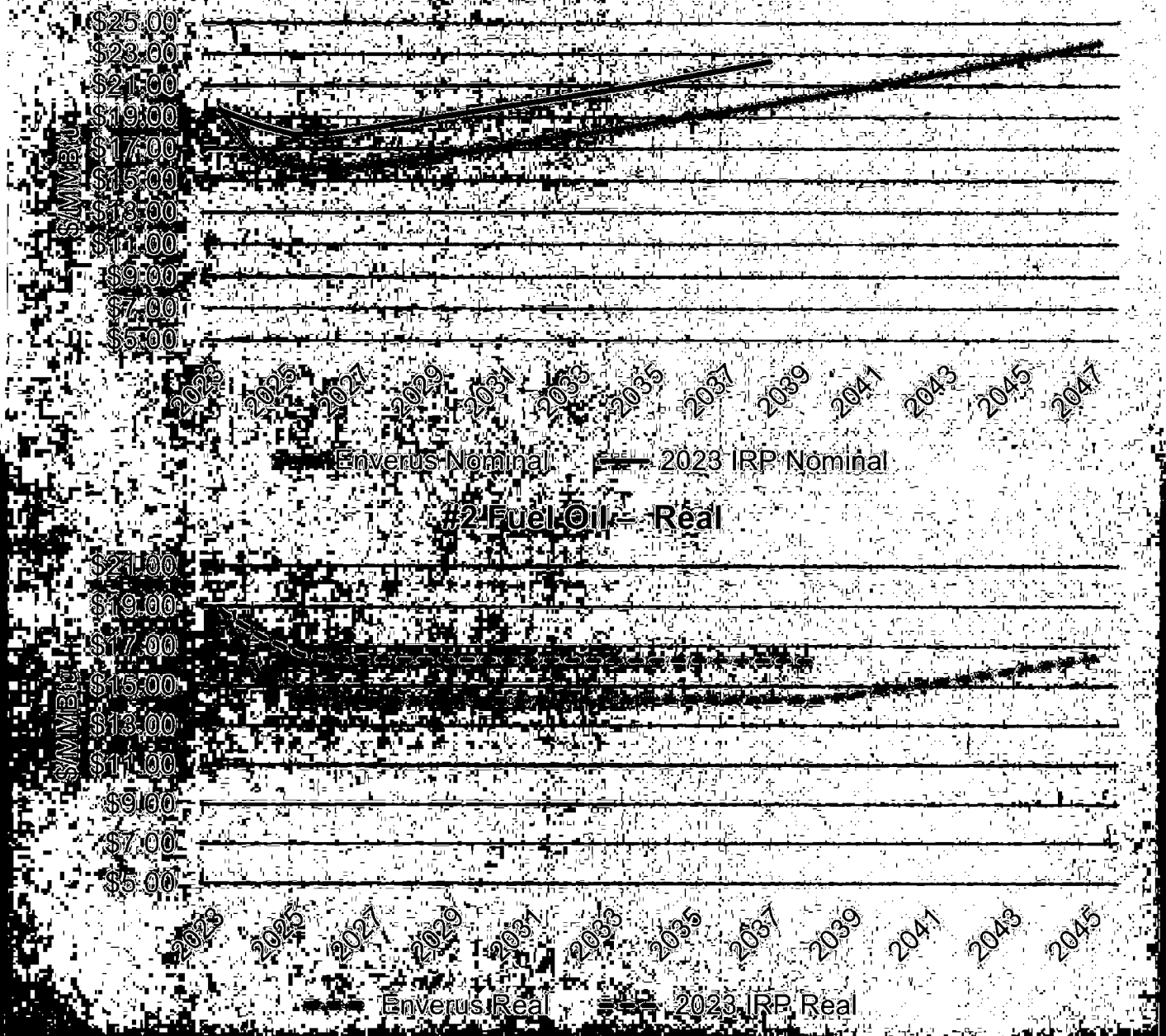
- The chart below presents the annual Coal price forecasts included in DEV IRPs for years 2012 through 2022.
- Historically DEV's CAPP CSX forecasts have been reasonable, including adjusting for the near-term volatility brought on by supply chain disruptions for coal and natural gas in Europe in 2022.

Historical IRP Forecasts vs Actuals – Coal (CAPP CSX)



Enverus 25-Year Price Forecasts – #2 Fuel Oil

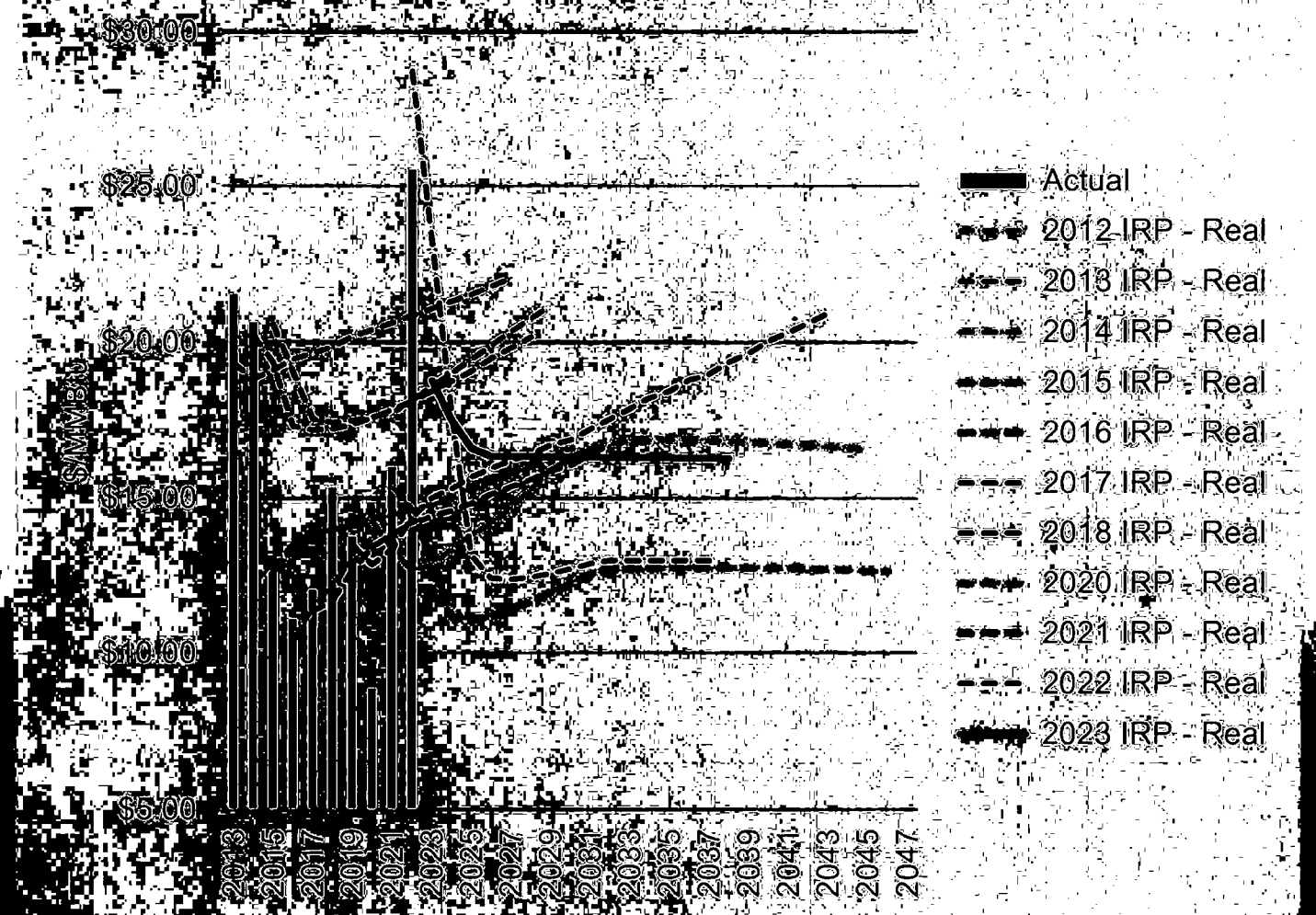
- Enverus relies heavily on observable market prices in developing its fuel oil forecasts and applies a 2% inflation rate per year beyond the active market horizon.
- Enverus and DEV's forecasts are similar and Enverus has no objection to DEV's #2 Fuel Oil price forecasts.
- Any differences are likely attributable to the difference in timing of when the forecasts were generated.



DEV Historical IRP Price Forecasts – #2 Fuel Oil

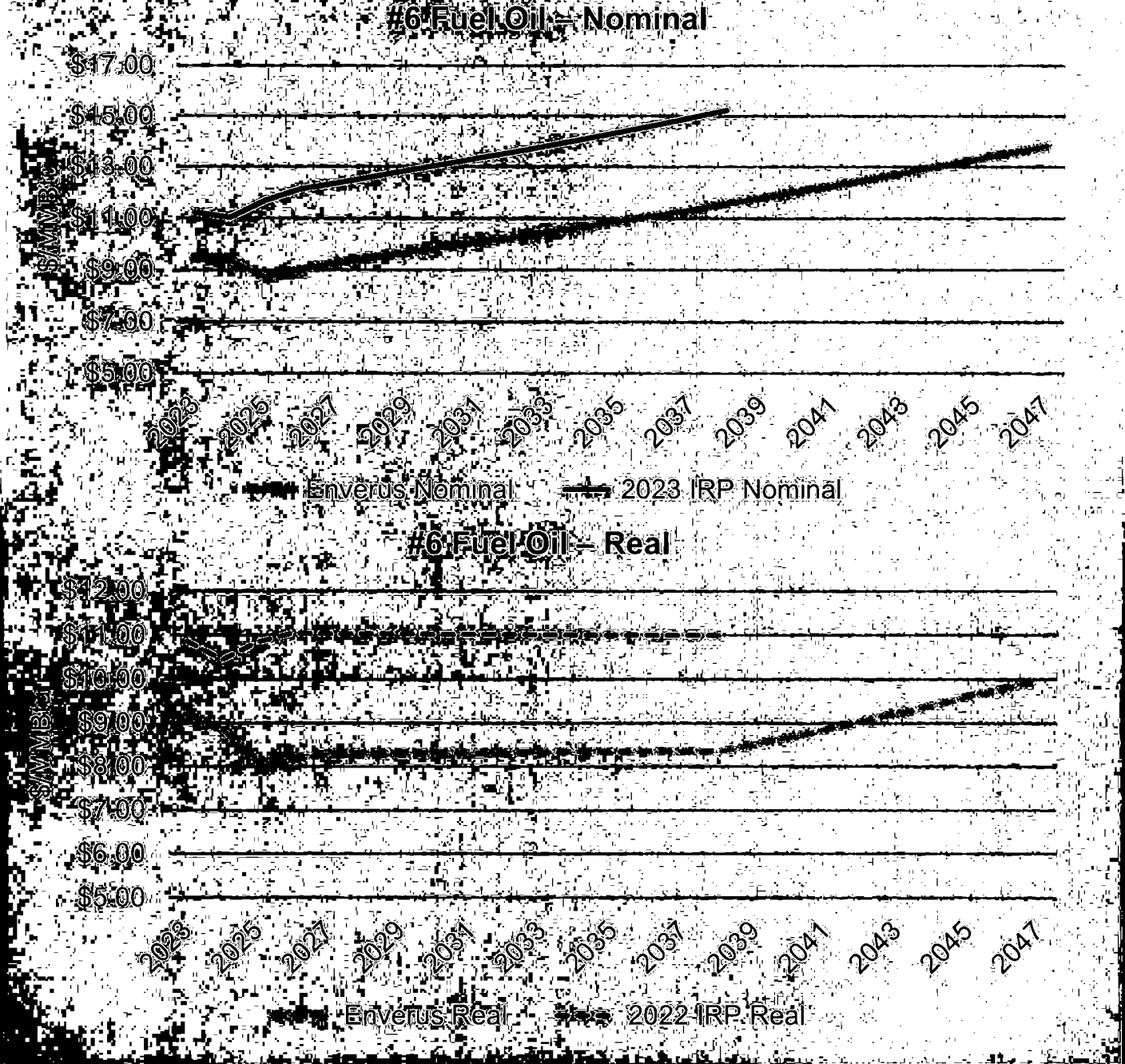
- The chart below presents the annual #2 Fuel Oil price forecasts included in DEV IRPs for years 2012 through 2022.
- Historically DEV's #2 Fuel Oil forecasts have been reasonable, including adjusting for the near-term volatility brought on by global events in 2022.

Historical IRP Forecasts vs Actuals – #2 Fuel Oil



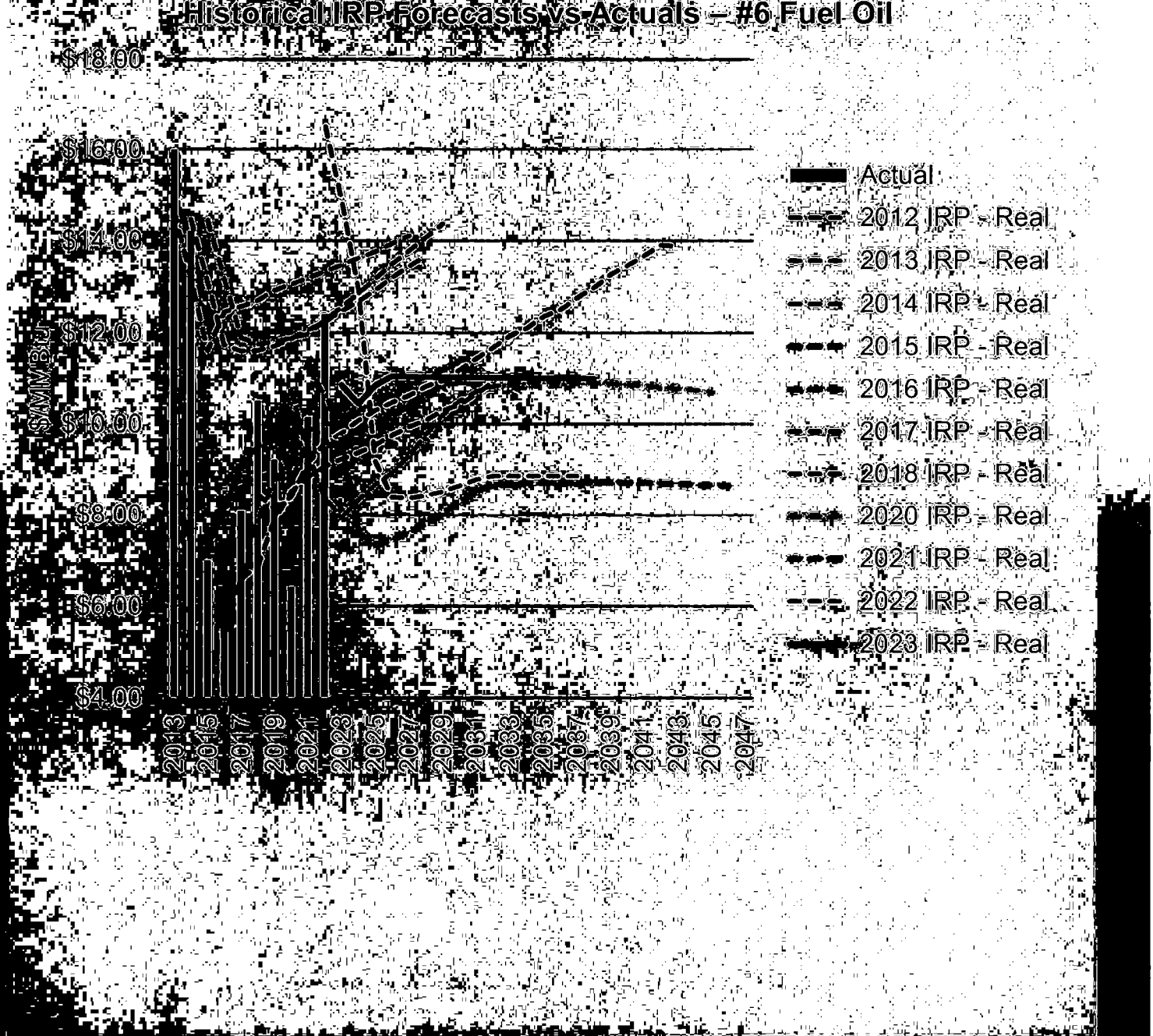
Enverus 25-Year Price Forecasts – #6 Fuel Oil

- Enverus relies heavily on observable market prices in developing its fuel oil forecasts and applies a 2% inflation rate per year beyond the active market horizon.
- Enverus and DEV's forecasts are similar and Enverus has no objection to DEV's #6 Fuel Oil price forecasts.
- Any differences are likely attributable to the difference in timing of when the forecasts were generated.



DEV Historical IRP Price Forecasts – #6 Fuel Oil

- The chart below presents the annual #6 Fuel Oil price forecasts included in DEV IRPs for years 2012 through 2022.
- Historically DEV's #6 Fuel Oil forecasts have been reasonable, including adjusting for the near-term volatility brought on by global events in 2022.

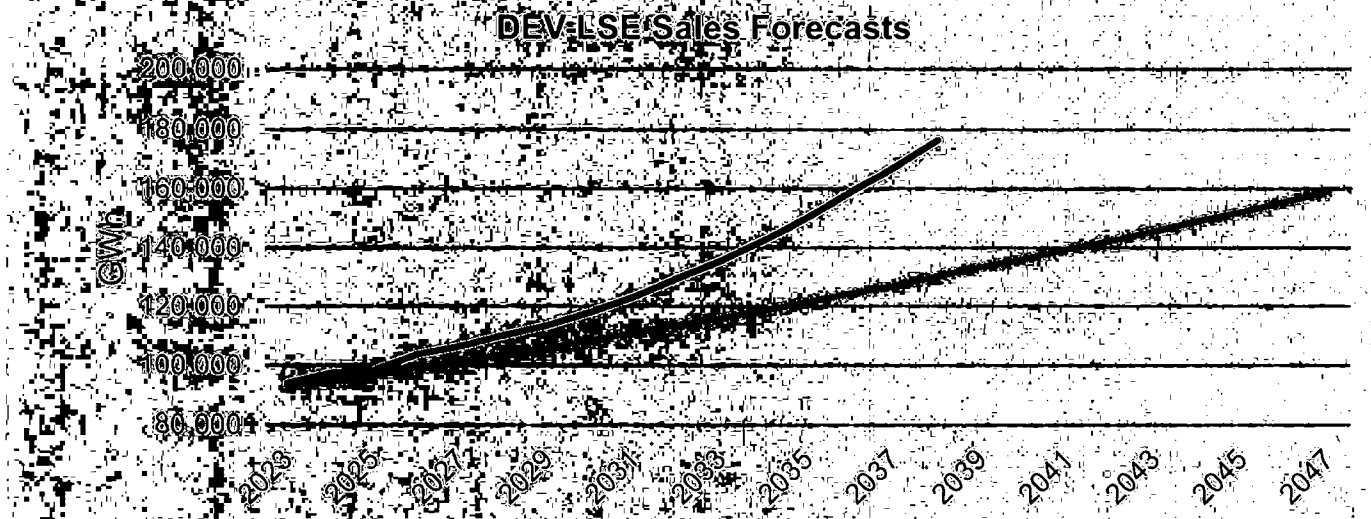


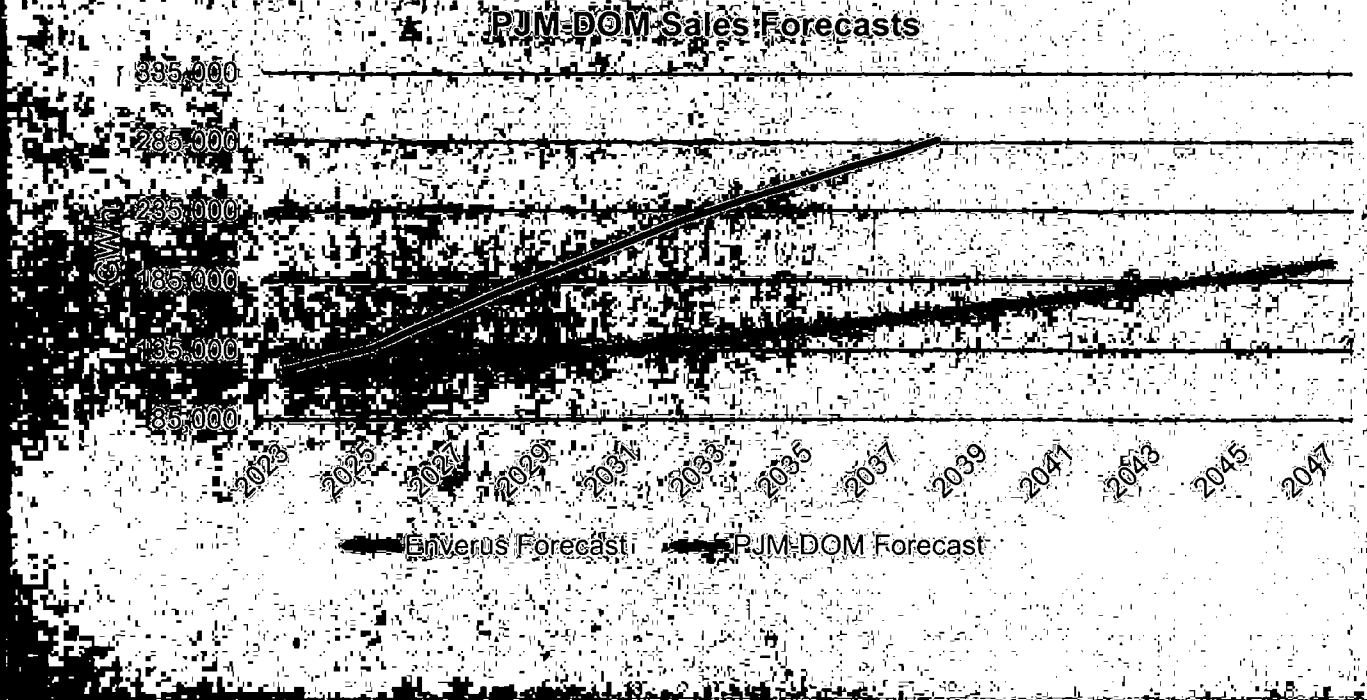
Energy Sales Forecasts

- Enverus's forecast methodology as explained in the Appendix considers historical data (provided by DEV for DEV-LSE and by PJM for PJM-DOM) as inputs to a neural network model which generates forecasts represented by the green lines on the next page.
- DEV uses PJM's issued forecast for PJM-DOM (lower chart) and scales down the PJM-DOM forecast to generate the DEV-LSE forecast (upper chart).
- The PJM issued forecast for PJM-DOM and the updated forecast from July can be found at: https://www.pjm.com/planning/resource-adequacy-planning/load-forecast-dev-process. The latest was issued on 05/22/23.
- Enverus's methodology considers all historical data and assigns higher weighting to signals prevalent in the most recently available observations.
- The DEV & PJM forecasts are higher than the Enverus forecast primarily due to the optimistic outlook for growth in data centers. Of the energy use sectors provided in the 2023 IRP Appendices (Tab 4A), Commercial is the only sector with substantial growth at 68% by 2038. The Residential and Industrial sectors are declining to 22% and 3% respectively.
- Enverus takes a more wholistic approach focusing on all the drivers of load not just data centers. Enverus is not as confident in data center load growth for two reasons:
  1. Load growth from data centers continues to pose a reliability challenge for PJM using their own "do no harm analysis". Referencing the latest Regional Transmission Expansion Plan (RTEP 2022 page 222) which states "Analysis will continue into 2023 as PJM opens a competitive proposal window seeking solutions to reliability criteria violations..." This implies current plans do not sufficiently accommodate this expected load.
  2. Data center demand is elastic. It is not tied to one geography. It will follow low costs of real estate & power prices for development signals (per Dominion's Data Center Forecasting report from June 2023: 10 out of 47 customers account for 90% data center demand YTD).
- The load growth that Dominion is forecasting is stronger than the actual load growth Enverus has measured in the entirety of ERCOT where Residential & Commercial sectors are growing driven by data centers & cryptocurrency. According to the Dallas Fed, Texas Job Growth outpaces the U.S. across most sectors. (Dallas Fed & Job Growth). While Virginia lags behind the U.S. across most industries. (Richmond Fed, see Industry Growth Chart). Comparing Y-O-Y percent changes from 2022-2023:

Energy Sales Forecasts

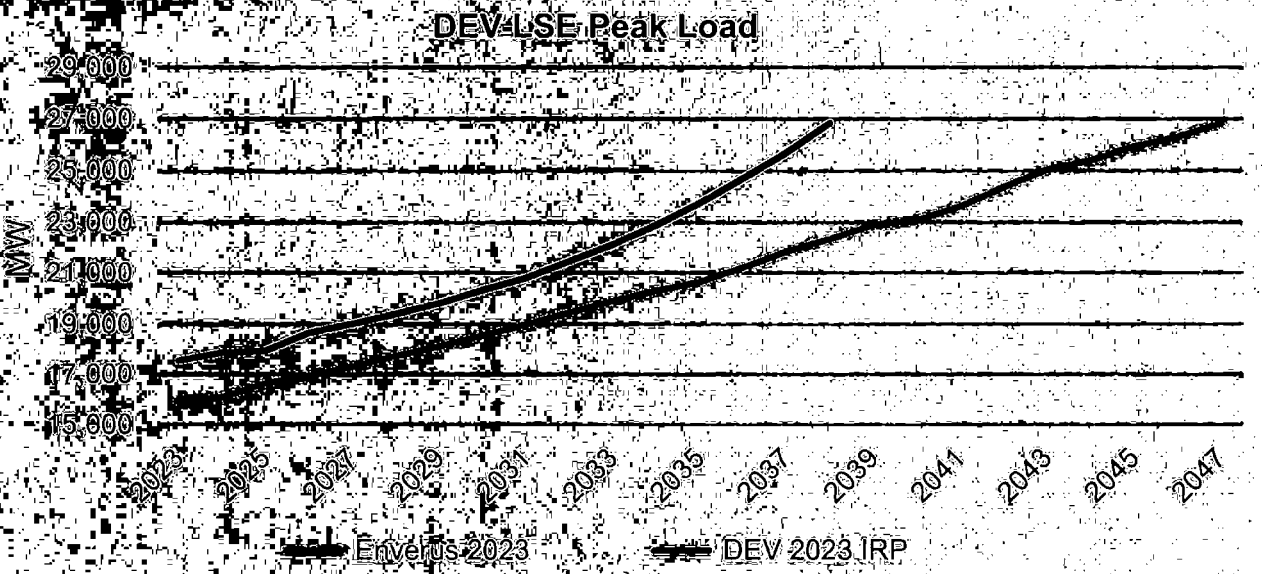
- These charts compare Enverus's energy sales forecasts for the DEV-LSE to the Company's forecast and for PJM-DOM Zone to PJM's forecast.
- The Company's LSE forecast refers to 2023 IRP Appendices – Electronic xls. Tab 4A

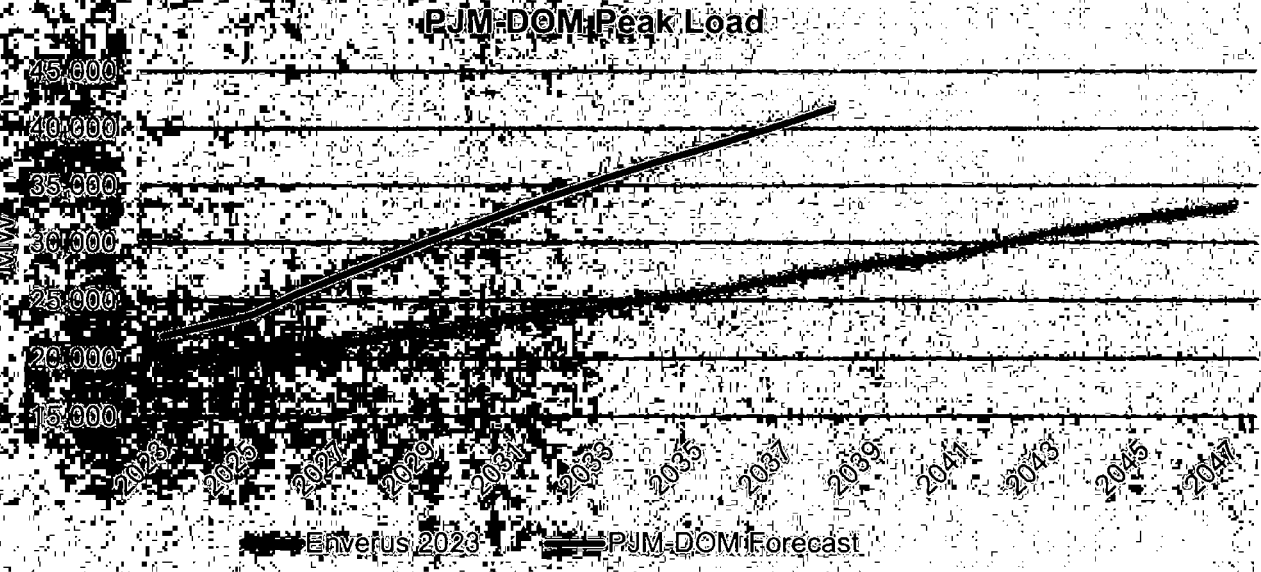




Peak Load Forecasts

- These charts compare Enverus's peak load forecasts for the DEV-LSE to the Company's forecast and for PJM-DOM Zone to PJM's forecast. The Company's LSE forecast refers to 2023 IRP Appendices – Electronic xls: Tab 2B (I-III)

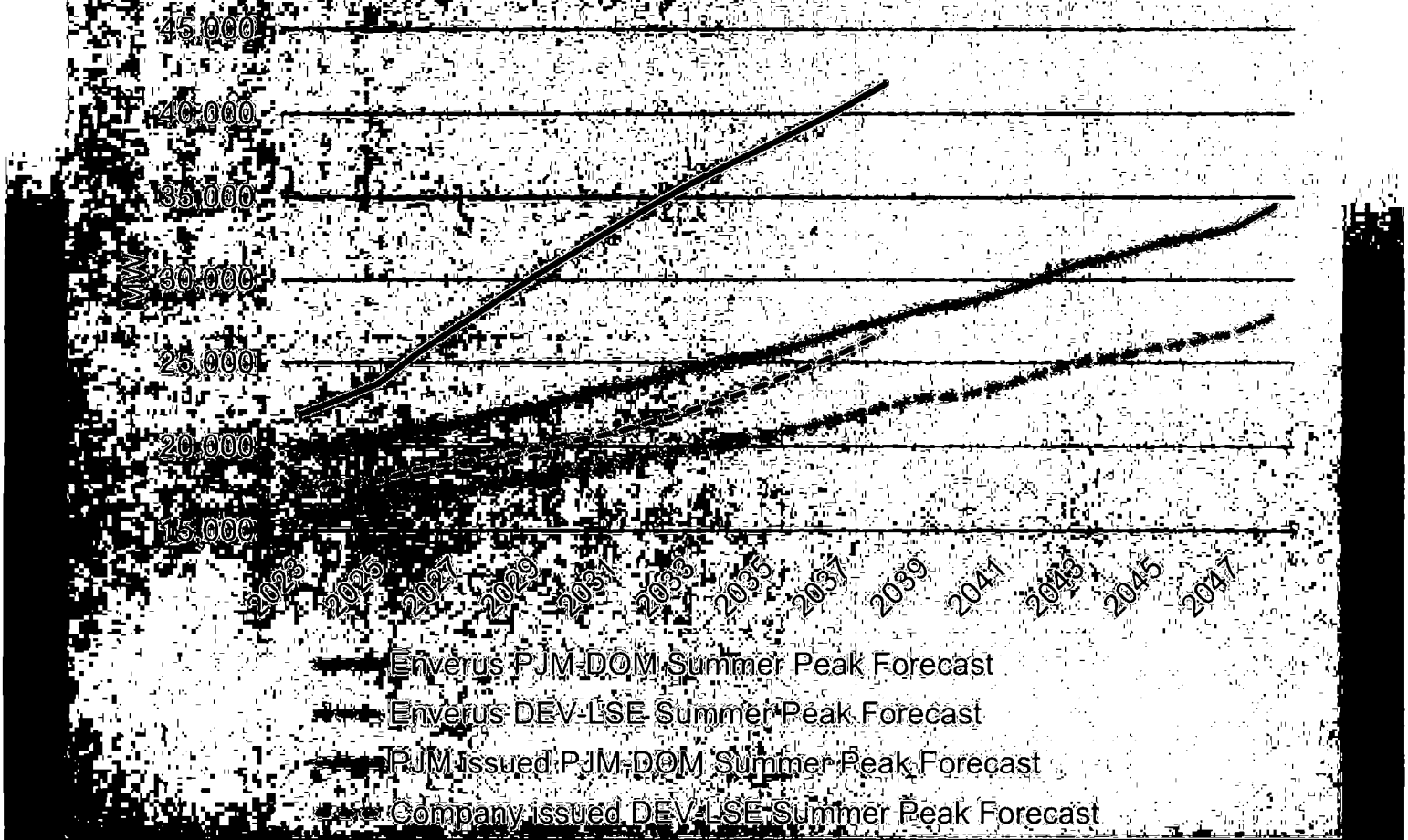




Summer Non-Coincident Peak Load Forecasts

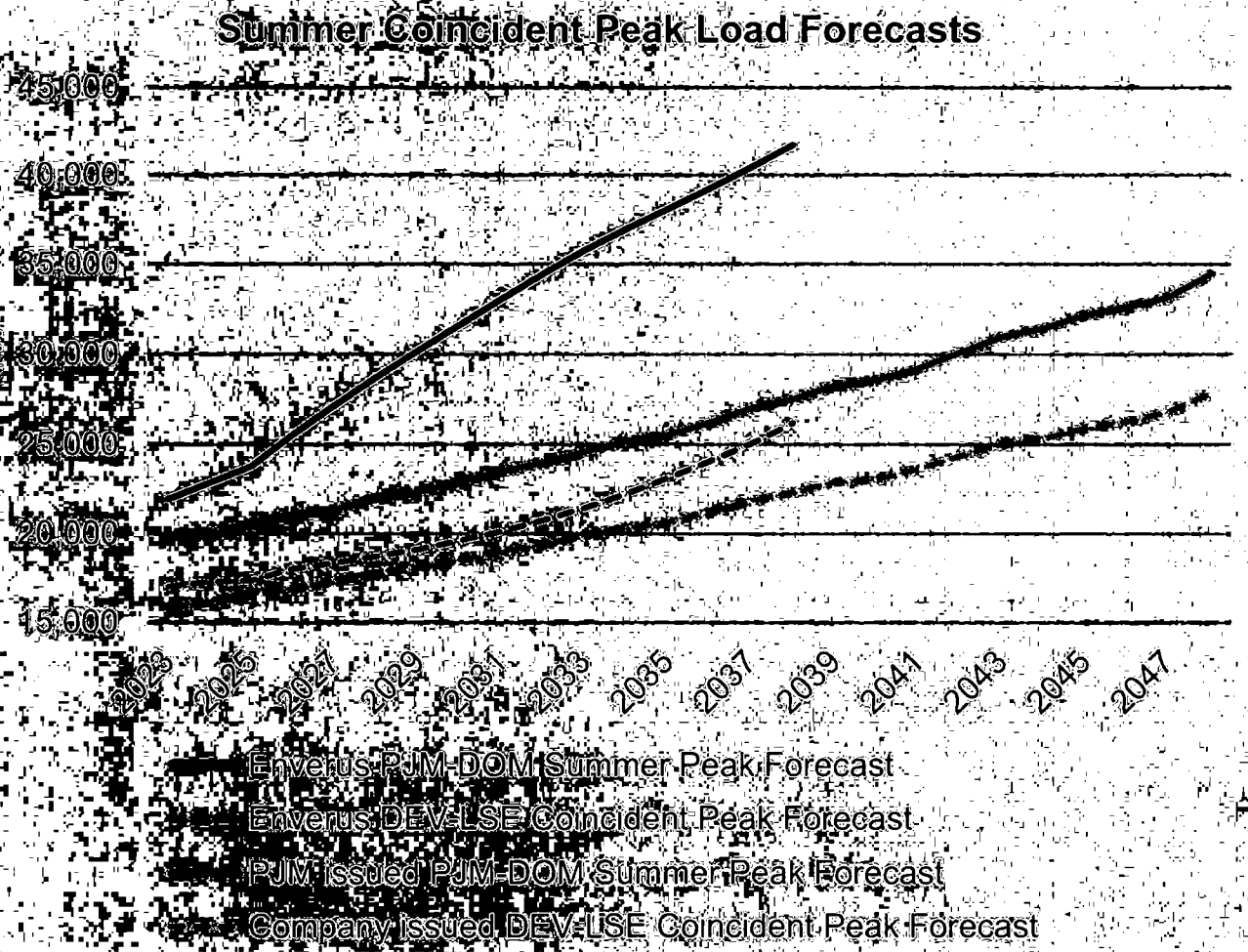
- The PJM-DOM forecast issued by PJM on 05/22/2023 is a summer peaking forecast. The Enverus forecast created for this report is also summer peaking.
- The Company appears to offer conflicting views. On Pg 29 of the 2023 IRP the Company refers to PJM-DOM as "winter peaking." However, on Tab 2b (i-ii) of the 2023 IRP Appendices – Electronic.xls the Company exhibits the summer peaking nature of the PJM issued forecast. However, recent historical data does not conclusively support PJM-DOM to be consistently winter or summer peaking.
  - 2015, 2017, 2018, 2019 were winter peaking in PJM-DOM
  - 2016, 2020, 2021, 2022 were summer peaking in PJM-DOM
- Enverus's forecast continues to anticipate both regions to be summer peaking, consistent with recent patterns.
- Enverus's forecasts differ from PJM's and the Company's for the same reasons the energy sales forecasts differed.

Summer Non-Coincident Peak Load Forecasts



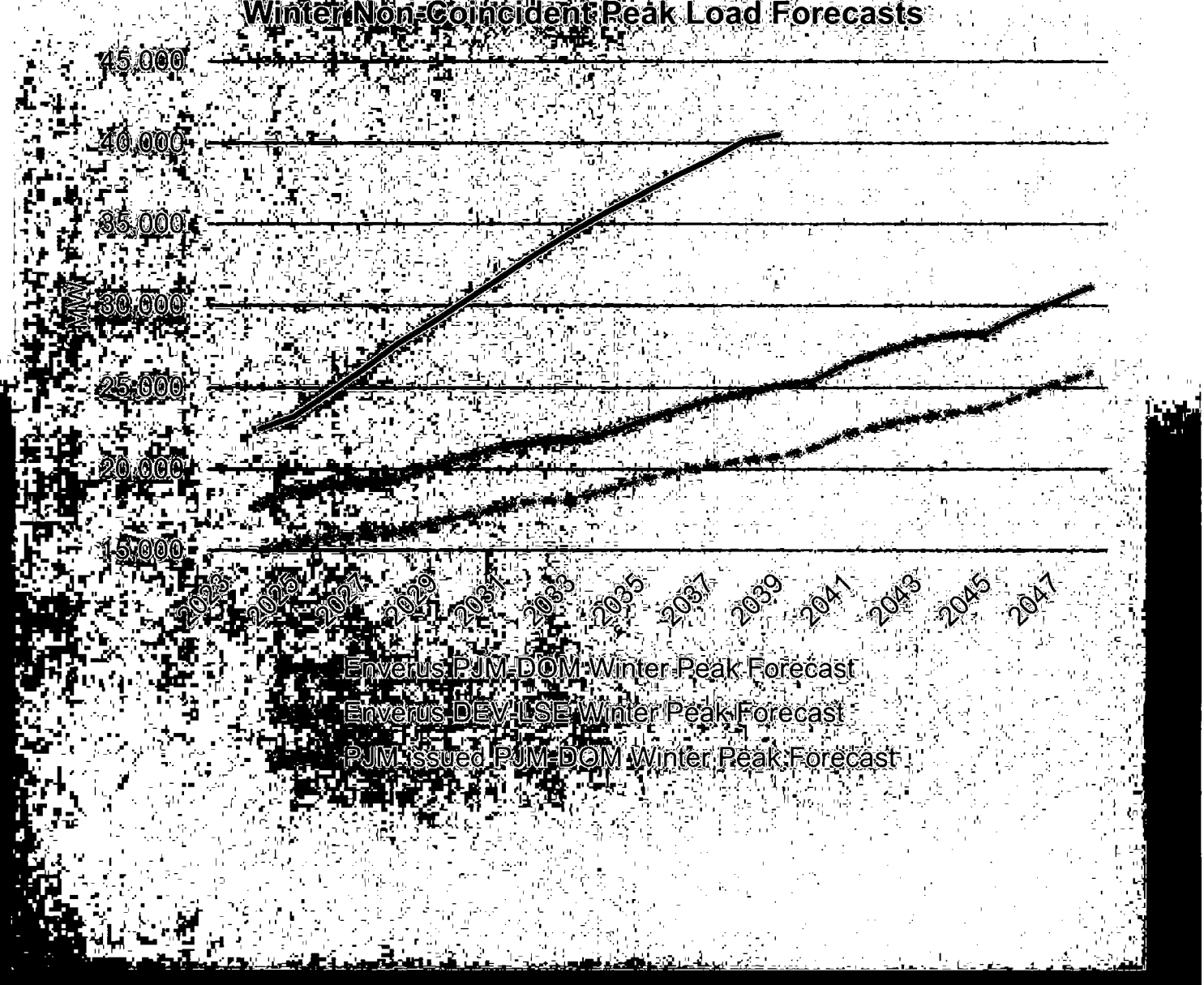
Summer Coincident Peak Load Forecasts

- The Coincident Peak lines in the chart below represent the peak load in the DEV-LSE territory on the same data that the peak load is occurring in PJM-DOM.
- There is not a meaningful difference between the peak load in the DEV-LSE on the non-coincident date and the coincident date. The territories are often peaking at or near the same time.
- The differences between the Enverus forecasts and the PJM and Company issued forecasts are attributable to the same reasons the energy sales forecasts differed.



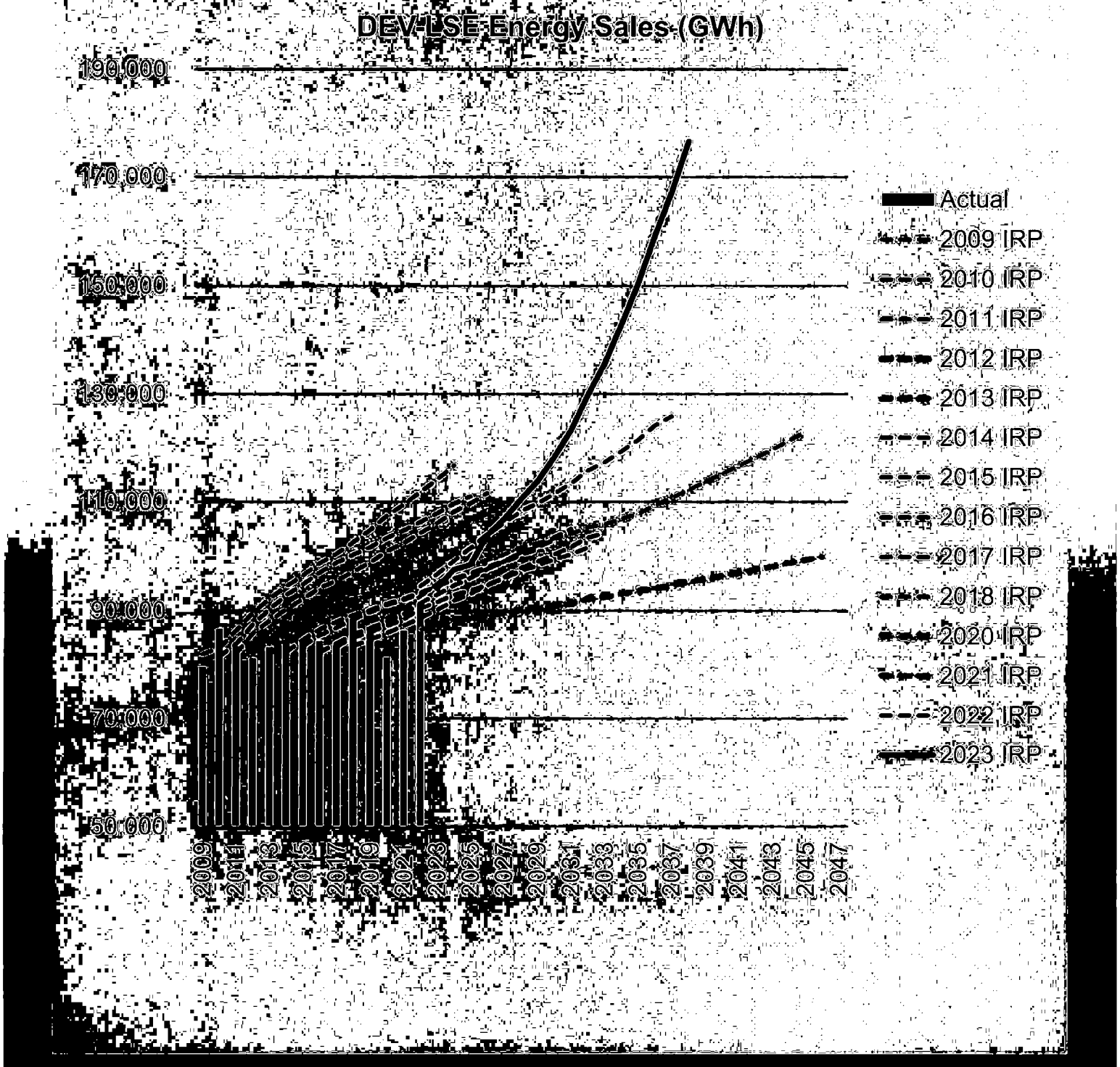
Winter Non-Coincident Peak Load Forecasts

- Both Enverus and PJM are forecasting PJM-DOM to be summer peaking.
- That said, winter peak forecasts are displayed here for reference.
- The Company did not provide peak forecast data for winters.
- Enverus's forecasts differ from PJM's for the same reasons the energy sales forecasts differed.



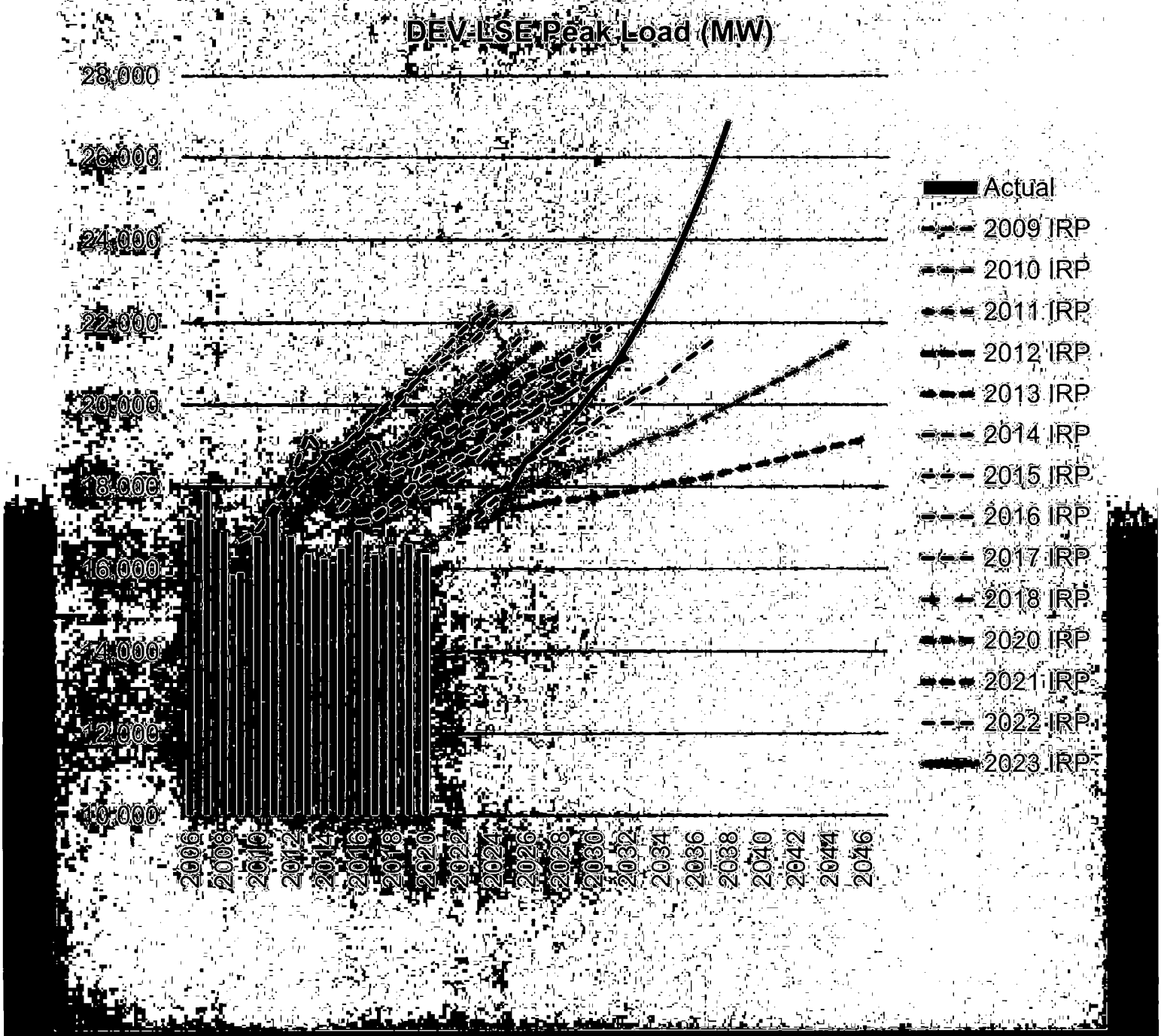
DEV-LSE Energy Sales Forecasts: 2009-2022 Historical IRPs

- The 2023 IRP has a notable change from the historical trend to a higher expected growth pattern.
- This is consistent with the changes in the PJM-issued forecast for the DOM Zone.



DEV-LSE Peak Load Forecasts : 2009-2022 Historical IRPs

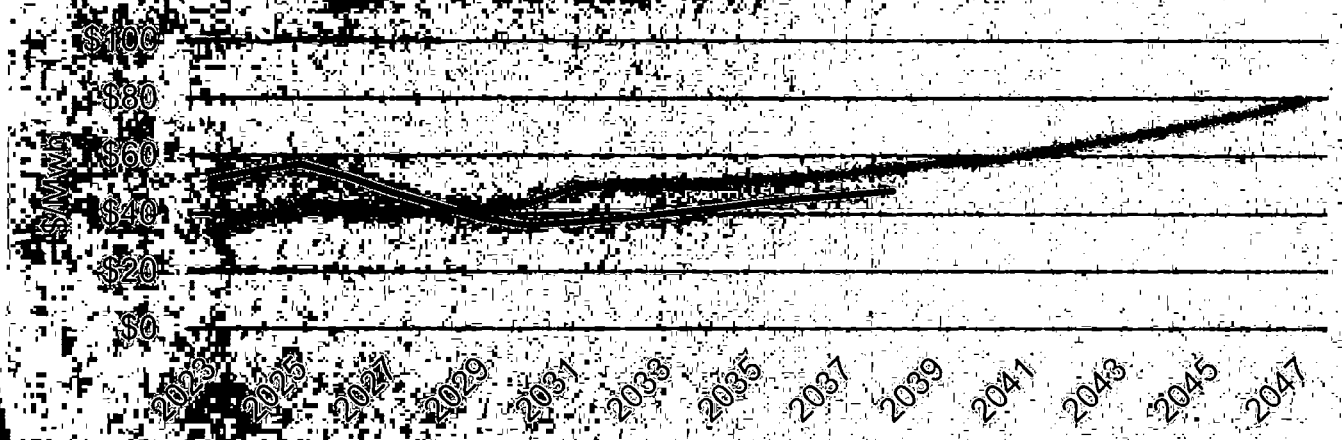
- The 2023 IRP has a notable change from the historical trend to a higher expected growth pattern.
- This is consistent with the changes in the PJM-issued forecast for the DOM Zone.



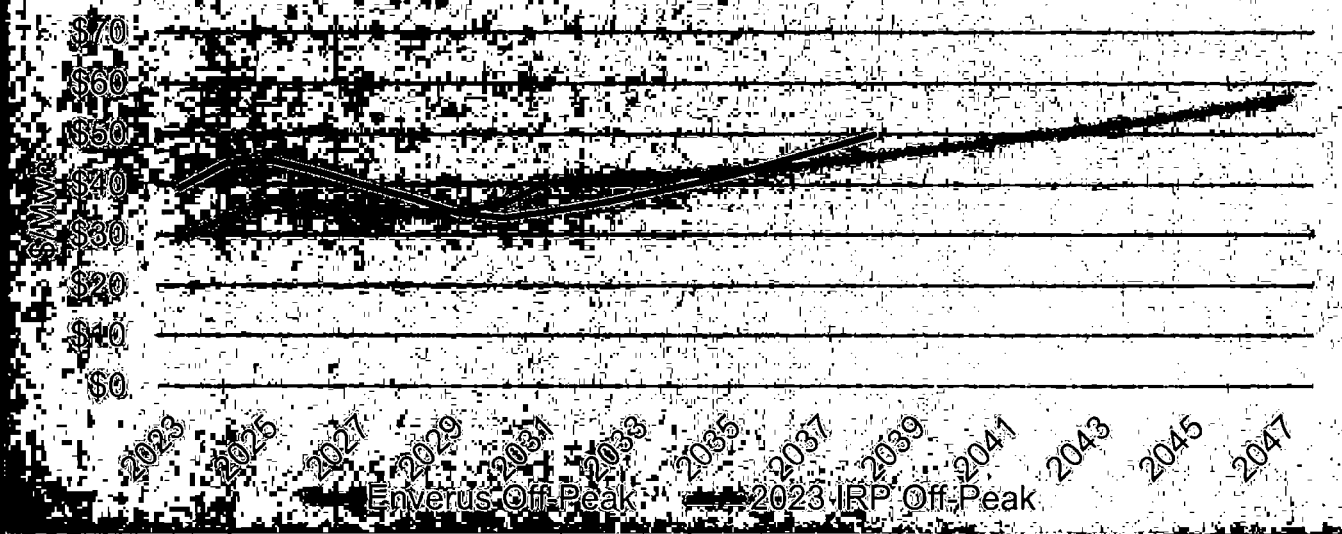
PJM-DOM Power Price Forecast -2023 IRP Vs Enverus

- Enverus's On-Peak & Off-Peak power price forecasts are lower in the near-term than DEV's due to timing differences for the forecasts as well as Enverus's more bearish view on near-term gas prices.
- Enverus is forecasting growing renewable generation over the 25-year forecast with 700 MW/year of new solar capacity, 200 MW/year of onshore wind & 100 MW/year of battery storage.
- The dip in the Enverus On-peak & Off-peak power price forecast for 2033 is due to the addition of 2,600 MW of coastal wind generation planned to come online off the coast of Virginia
- With those differences noted, Enverus does not object to DEV's forecast.

PJM-DOM On-Peak Power Price Forecast

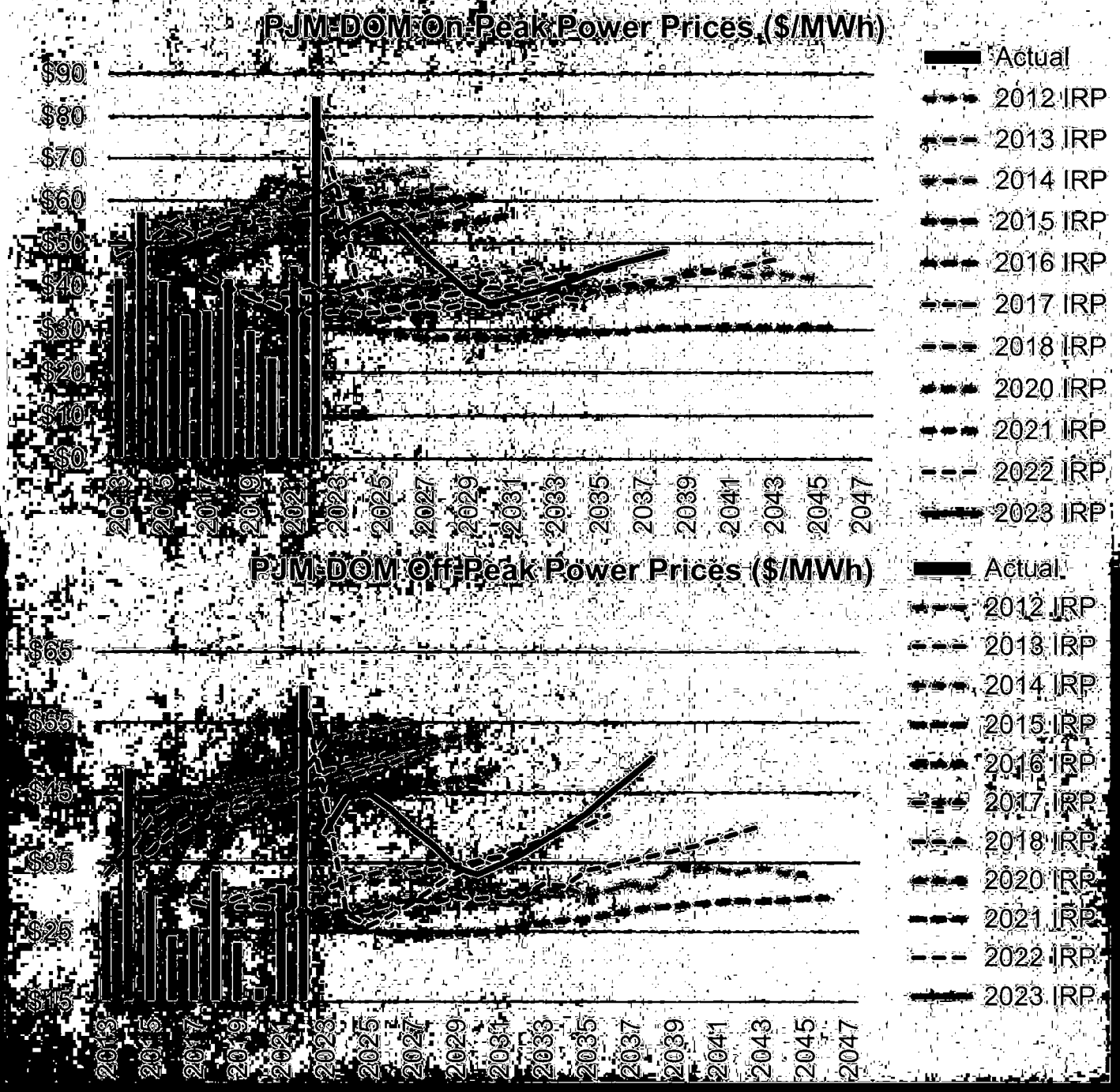


PJM-DOM Off-Peak Power Price Forecast



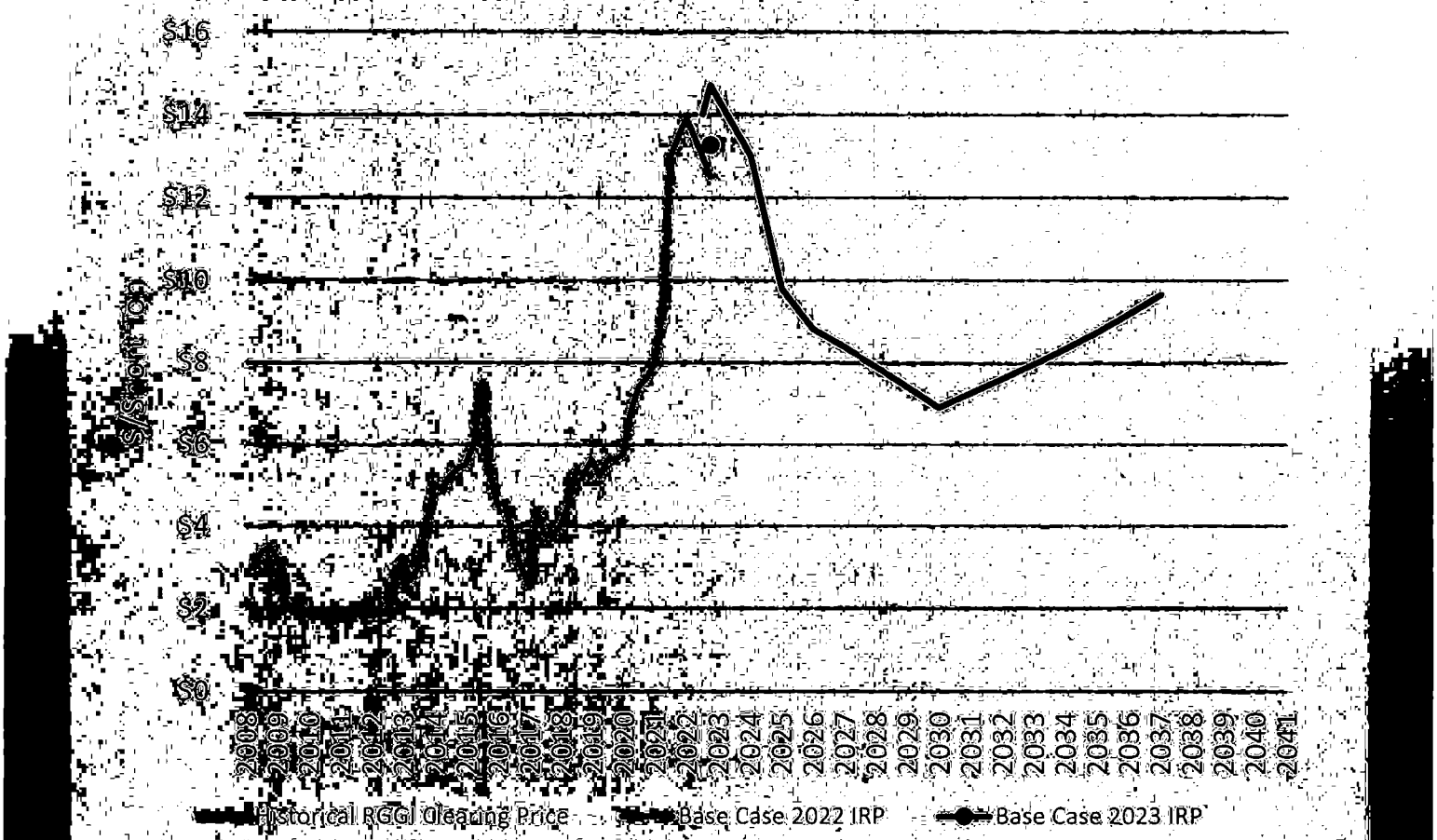
PJM-DOM Power Price Forecasts – DEV Historical IRPs

- DEV's forecasts traditionally exhibited significant positive trajectories despite flat to declining actuals. This pattern softened in 2017 but remained positive.
- The 2022 IRP adjusted upward due to the volatility experienced in 2022 and has been reasonably adjusted downward in the 2023 IRP.



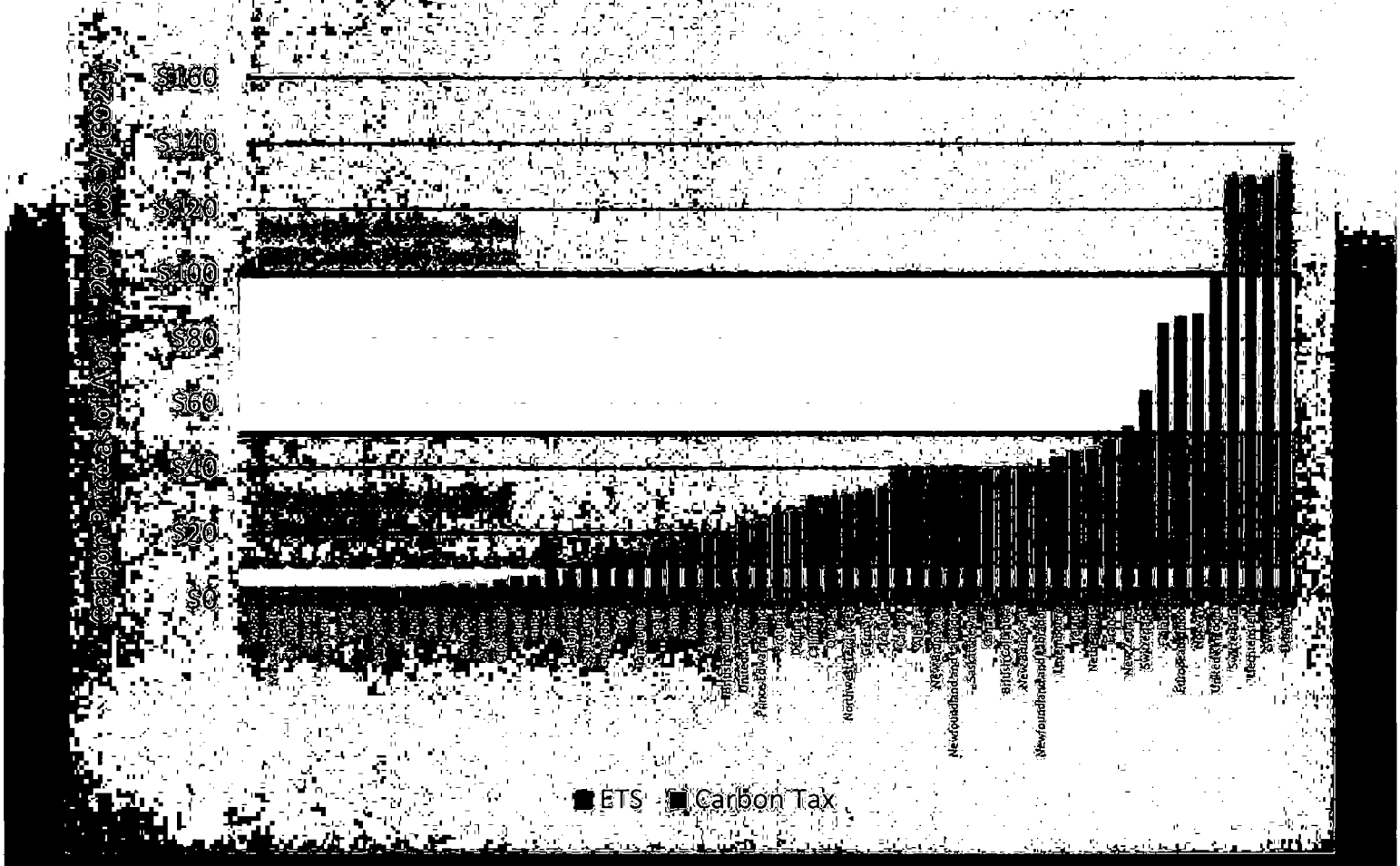
Regional Greenhouse Gas Initiative (RGGI) and National CO_2 Pricing

- Virginia joined the RGGI in 2020, though in 2022 the state's current governor issued an executive order seeking to remove Virginia from RGGI. The 2023 IRP represents this expectation by offering only one observation (compared to the 2022 IRP below).
- External RGGI forecasting is not readily available, and we view the single 2023 IRP observation as reasonable.
- We believe the price of carbon credits will remain volatile given the rapidly shifting market dynamics. If Virginia remains in or re-joins RGGI it would be prudent to extend the forecast beyond 2023 to address the full planning period.



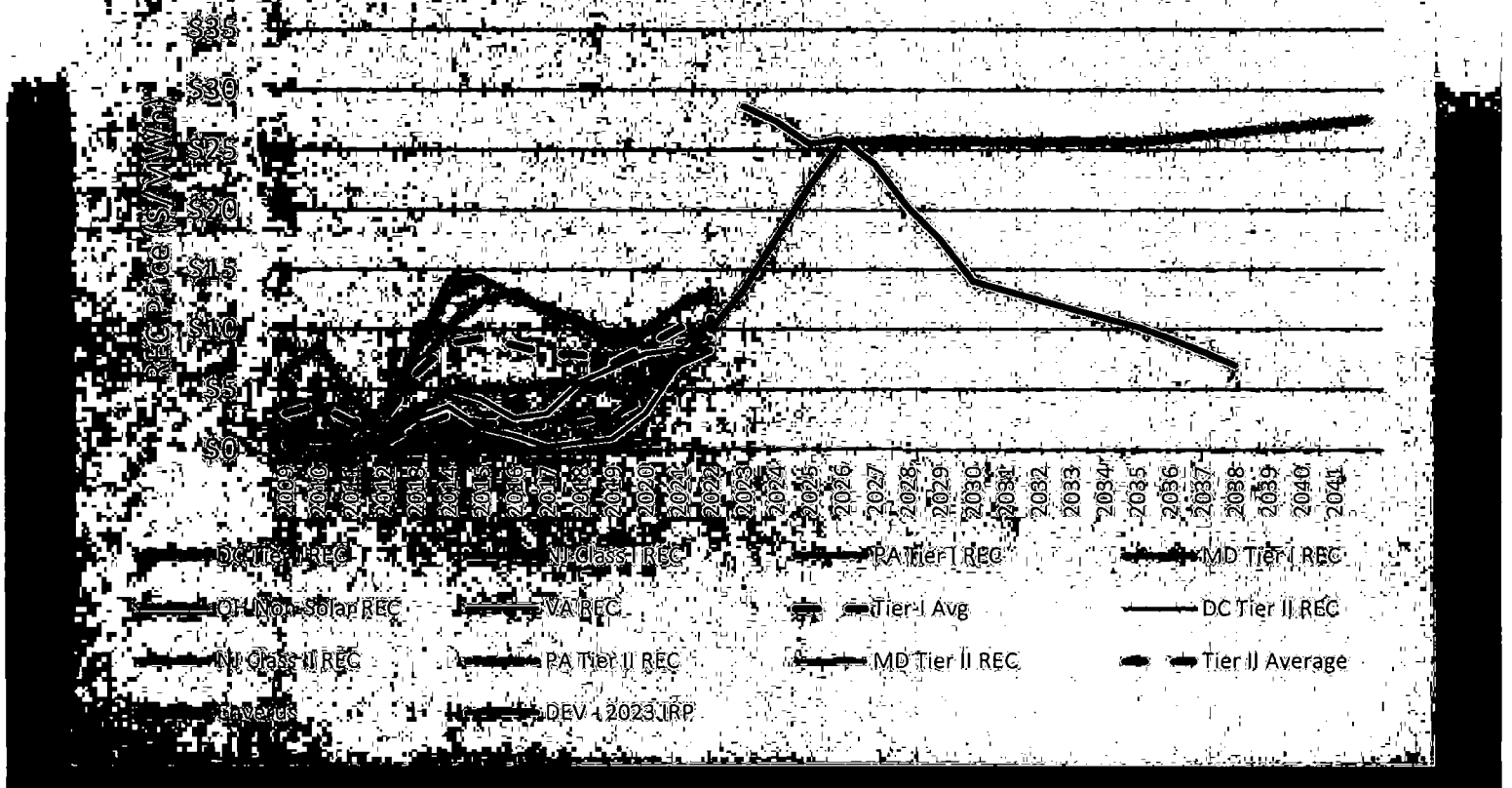
Regional Greenhouse Gas Initiative (RGGI) and National CO_2 Pricing

- The 2023 IRP assumes a nominal national CO_2 price starting in 2036 escalating from to $3.18/ton to $9.93/ton over three years.
- There will always be considerable uncertainty about the U.S. adopting a national carbon price due to the political nature of such a policy and range of potential outcomes.
- The assumed $3.18/ton to $9.93/ton price would be towards the low-end of existing national carbon prices and below the low-end of the $50-$100/ton carbon price corridor recommended by the World Bank for 2030.
- That said, we do not believe the U.S. will adopt a national carbon price in the near term and if/when it does it will likely be introduced at the low-end of the global spectrum.
- Given this view we believe the price assumed in the IRP is reasonable given the uncertainty in this market.



Renewable Energy Credit (REC) Forecast

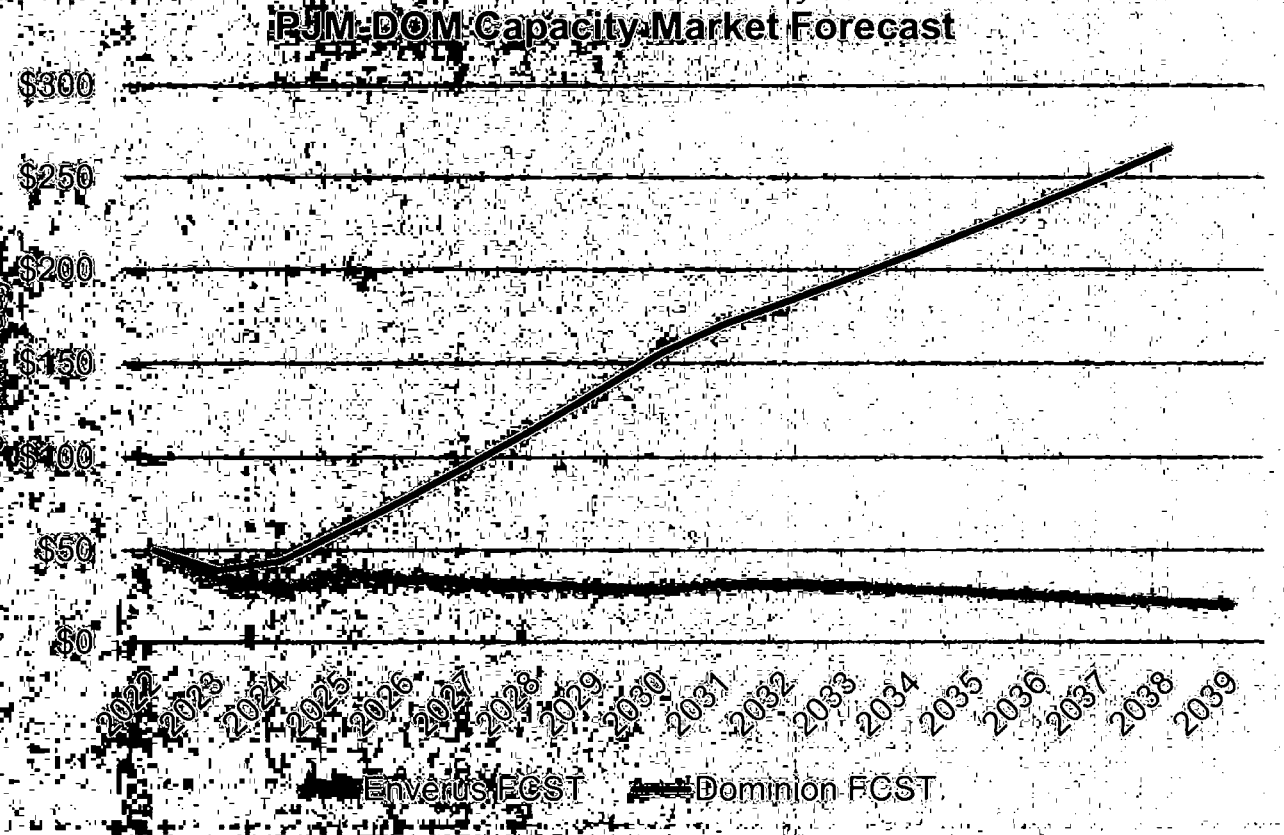
- PJM REC transacted volumes and historical pricing are opaque, challenging effective forecasting. DC, PA, NJ, MD and VA provide the most transparency where Tier I & II REC prices recently trended up.
- The Company forecast begins with prices well above historical levels. Enverus does not see evidence to support these bullish trends.
- Beginning in the late 2020's into the 2030's the Enverus forecast remains elevated as compared to the Company's. Enverus believes increased Renewable Portfolio Standards (RPS), from states like NJ and MD as well as DC, will encourage more thermal assets to purchase RECs, driving prices higher.
- In addition, Enverus anticipates increased buying from corporate buyers desiring zero emissions qualifications. The 2023 PJM Market Monitor report offers early evidence of this. "The current REC production from PJM generation resources was not enough to meet the state renewable requirements for the first three months of 2023."
- Given the opaque market, risk to offshore wind project timelines, and uncertainty in future REC prices, we believe it prudent for DEV to run a higher REC pricing scenario as part of its planning.



PJM-DOM Capacity Market Forecast

- The Enverus forecast is created by calculating the actual heat rates from the Delivery Years (DY) 24/25 auction results. The actual heat rates are multiplied by gas forward market prices referencing Transco Z5.
- The bearish trend in prices from the last several auctions can be attributed to a combination of regulatory changes from PJM via FERC. Enverus believes this heavy-handed approach is unlikely to change in the future. Ultimately consumers are already burdened by existing capacity prices and FERC appears to have little appetite to support increasing this burden. See (PJM Capacity Market Forum).
- The "PJM Energy Transition" is underway and expected to continue. This is bolstered by state policies and federal policies especially the IRA. This creates headwinds for future bullish Capacity Price trends as state subsidies will continue to incentivize new generation to enter the PJM market.
- During this transition we expect stronger price signals 2025-2028 as thermal retirements outpace the renewable expansion. However, we do not share Dominion's outlook for bullish, actually record-breaking capacity prices, for a decade.
- For this to be true, project developer capital would have to ignore these price signals. This is not what has happened historically in the PJM Capacity Market. Delivery Years in which high prices are measured are followed by weaker price signals.
- From 2029 forward, the expansion of the renewable footprint accelerates. This should put downward pressure on Capacity Prices and mute the impacts of load growth in Dominion's territory.
- Beyond 2033, the 2,600 MW offshore Coastal Virginia Wind Farm (27 miles off the coast of Virginia Beach) along with additional small nuclear reactors will begin to decrease capacity prices.
- The Enverus forecast as compared to the Company's forecast is displayed on the following page.

PJM-DOM Capacity Market Forecast (continued)



Conclusion

- Price Forecasts for both fuel and power prices between the Company and Enverus do differ but not in an unacceptable manner.
- The three areas where Enverus differs most from the Company are:
  1. Energy Sales and Peak Load forecasts
  2. Capacity Price forecast
  3. REC Price forecast
- Currently Enverus is not recommending the Company adopt the same methodologies Enverus employs. However, it is important to note:
  - Enverus has a reputable track record in developing energy market forecasts and our outlook for datacenter load growth at this time is positive but lower than the Company's.

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Appendix

Energy Sales and Peak Load Forecast Methodology

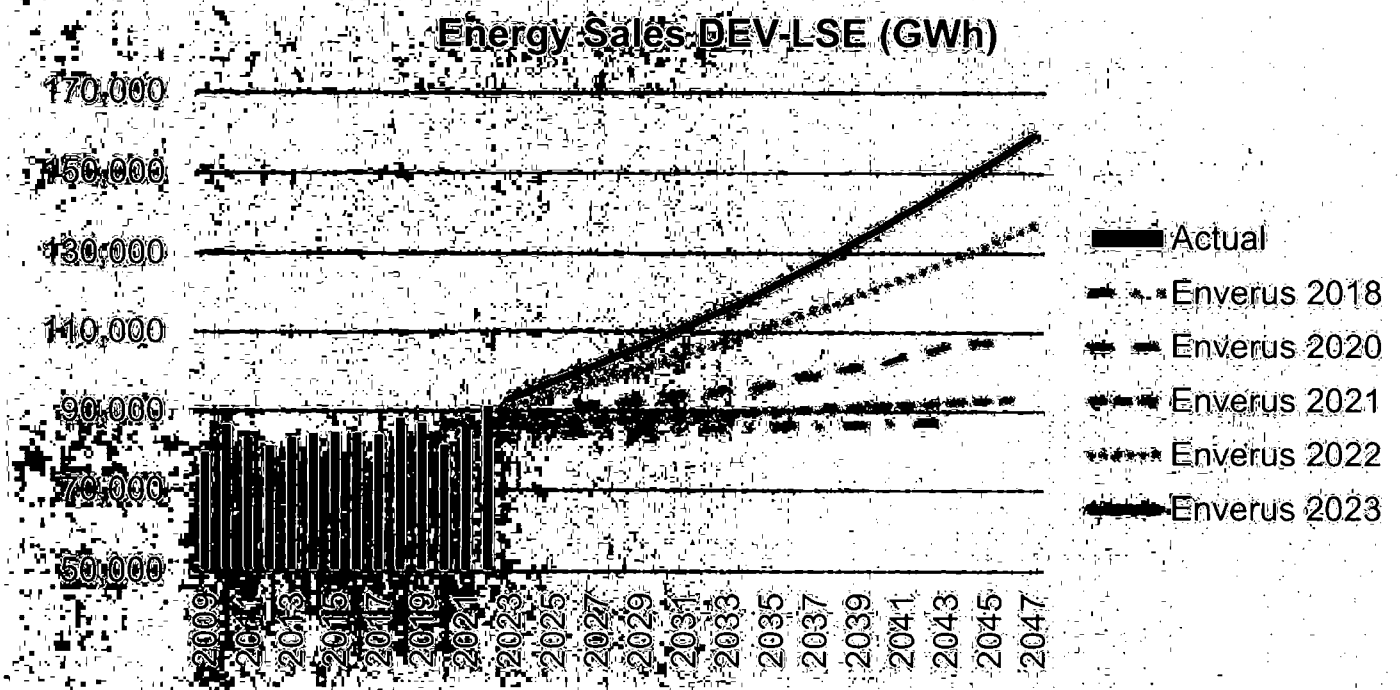
- Enverus's proven expert load forecasts are generated by Pattern Recognition Technologies Inc. (PRT), acquired by Enverus in December of 2017.
- PRT employs artificial neural network technology (ANN) to the core of all forecasting products.
- ANNs are computer models that are inspired from the way biological brains are organized and function. Forecasting has been one of the most successful ANN application areas where traditional techniques such as regression analysis have limited success, especially in the case of complex and nonlinear processes.
- Forecasting is viewed as a pattern mapping task whereby an input pattern consisting of factors affecting the variable to be predicted is to be mapped into the desired output.
- In short-term electric load forecasting, future load is highly dependent on several factors such as weather condition, calendar effects, recent load trends, etc. The correlation between these factors cannot be explicitly derived. However ANNs can model this mapping/correlation through training with examples from historical data.
- An iterative adjustment scheme is repeated until the ANN outputs are sufficiently close to the desired outputs and the *trained* ANN is subsequently used for production-level forecasting.
- The use of ANNs for long-term forecasting requires assumption about the weather condition for the forecast period.
- Typically a 'normal' weather scenario is used for this purpose. This weather scenario is generated by averaging actual weather of several past years. This average is then used as the required weather input for the ANN models.

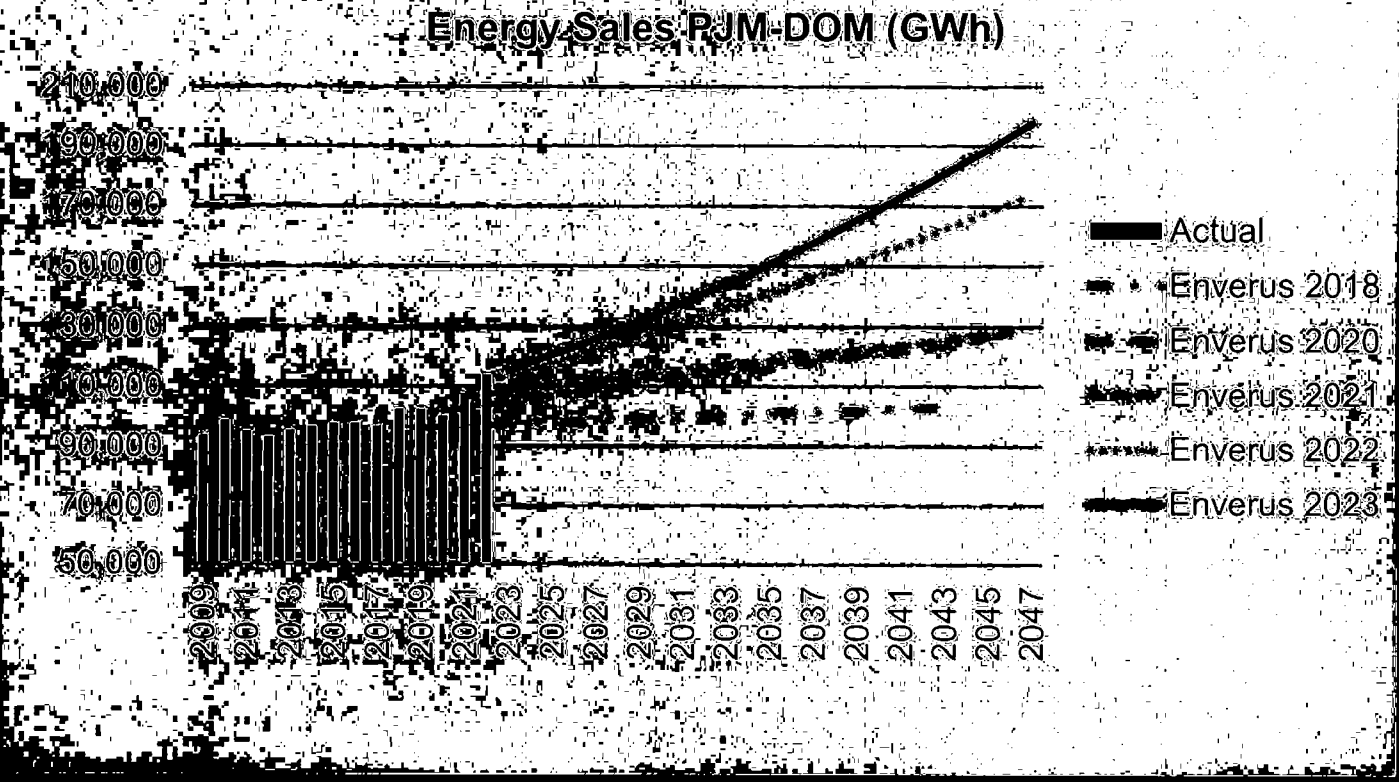
Enverus Power Price Forecasting Methodology

- Power prices are forecasted using a fundamental model of supply and demand. The key assumption is that power prices are directly related to the marginal variable costs incurred by power generation for a specific load.
- The supply curve is created by estimating fuel, and variable operations and maintenance costs for each power unit in PJM-DOM using infrastructure data from the IRP PJM, Enverus project data, and analyst research.
- For natural gas and coal fired plants, the Enverus price forecasts are applied to the most recent reported annual heat rates to calculate fuel costs. For other fuels and for all operations and maintenance costs, the most recent reported annual figures are used.
- All announced builds and units that have announced future retirement are incorporated into the forecast according to their reported in-service or retirement dates.
- Seasonal capacity factors and hourly generation shapes are applied to wind, solar, and nuclear power units. Assuming that lower-cost units are dispatched first, the units are sorted by variable operating cost to create the supply curve.
- A fixed operations cost that increases by 1% per year is added to the supply curve to account for the non-variable part of operations, maintenance, and compliance.

Enverus Historical Energy Sales Forecasts

- Enverus's forecasts evolve over time in response to actual results but typically exhibit a consistent, if less exuberant, long-term outlook.





Enverus Historical Capacity Market Forecast

- Enverus's forecasts for the past two cases exhibit a consistent pattern. Differences are mostly attributable to changes in the gas market outlook.